Valuation and modelling for investment bankers

ROTHSCHILD

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At various points in the manual a number of financial analysis issues are examined. The financial analysis implications for these issues, although relatively standard in treatment, remain an opinion of the authors of this manual. No responsibility is assumed for any action taken or inaction as a result of the financial analysis included in the manual.

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Executive summary

This manual examines the main techniques used by investment bankers to value companies, including the use of Excel for modelling. It focuses on valuation for M&A transactions, rather than valuation and analysis for ongoing equity research.

The three main techniques employed in valuing a target company are covered:

- Comparable company analysis, or comps
- Precedent transactions analysis
- Discounted cash flow, or DCF (both fundamental and advanced)

The common pitfalls and key issues with each of these methods are also considered.

(Note: Leveraged Buyout (LBO) analysis is covered in detail in the 'Financial Products' manual.)

Best practice for successful modelling is explored, along with an introduction to the Rothschild standard models. The manual also provides an introduction to Excel 2007, which should prove a useful aid in the near future.

Comparable company analysis

Overview

The chapter takes a four step approach to comps:

Step 1 Identify the comparable universe of companies

Step 2 Focus on the appropriate financial metrics and ratios

Step 3 Standardise the metric and calculate the comparable multiple

Step 4 Use the multiple to value the target

In essence the approach is to decide on a group of comparable companies, take the market value of the equity and debt for each and divide by an appropriate figure from the income statement or cash flow statement. The extracted figures may require 'cleaning up' for accounting inconsistencies,

before being used to calculate an average sector multiple. The average multiple is then applied to the target company to establish a value.

For example, if one of the comparable universe of companies has a market capitalisation of $5bn and debt with a market value of $1bn, its enterprise value or EV is $6bn. This figure would be adjusted to take account of associates, joint ventures, pension deficits and the like (all covered in detail later). This EV would then be divided by an appropriate figure, such as the forecast EBITDA.

So if EBITDA was $500m and EV was $6bn,

EV/EBITDA = 12

This multiple of 12 would be used alongside the multiples of the other comparable companies to gauge the sector average EV/EBITDA multiples. These sector averages can then be used to calculate the indicative values of the target company.

For example, with an average range of EV/forecast EBITDA from the comparable universe:

EV/EBITDA	
High 13	Target company forecast EBITDA $100m – implied value $1.3bn
Low 10	Target company forecast EBITDA $100m – implied value $1.0bn

Precedent transaction analysis

Overview

The way precedent transactions are analysed is similar to comps, the key difference being that rather than looking at comparable trading companies' multiples, the multiples (often EV/EBITDA) are drawn from previous relevant transactions. The price paid for similar companies in the past is used to determine the value of the target.

If the relevant precedent transactions were for listed companies, the premium paid over the pre-bid share price can also be used for valuation.

For example, if relevant, recent transactions have been completed at an average premium of 35% over the pre-bid (or pre-rumour) share price, the target company shareholders will be expecting a similar premium – so the price offered per share will have to incorporate this to have a chance of success.

Discounted Cash Flow (DCF)

Overview

The major way that discounted cash flow is used for valuation is to discount the unlevered free cash flows expected from the company, at the weighted average cost of capital (WACC) to establish an enterprise value (EV).

The WACC is calculated by weighting the cost of equity (Ke) and the post-tax cost of debt (Kd) according to the relevant proportions of equity and debt in the target company.

The calculation of free cash flow

EBIT	5,000
Add back	
Depreciation	600
Amortisation	100
EBITDA	5,700
Deduct	
Capex	1,000
Tax (on operating profit)	700
Increase in working capital	500
Free Cash Flow (FCF)	**4,500**

Each future year's free cash flows are calculated, and then discounted at the WACC to determine the present value. The sum of all of the present values of the future free cash flows results in an implied enterprise value.

This is usually achieved by forecasting a number of years' free cash flows discretely (often 10 years), and then using a perpetuity formula to establish a terminal value for the cash flows anticipated beyond the forecast period.

This process will establish a 'standalone' value for the company, valuing it independently of any synergies that may arise if it were acquired. Indeed, the value must be 'standalone' because the WACC used to discount the cash flows is based on the target's capital structure, not the potential acquirer's.

Other DCF valuation techniques, such as discounted dividend valuations and FCF to equity, are examined separately.

Merger analysis (combination)

Overview

For acquisitions by listed companies, it is important to forecast the impact of the combination on key metrics such as EPS and credit ratings. At this stage, the potential synergies of bringing the two companies together need to be considered.

The merger model will deliver forecast EPS, together with the implied credit rating. The credit rating itself will be dependent upon the capital structure of the combination.

The manual then moves on to review the models used by Rothschild to use these valuation methods in a robust and integrated way. The final two chapters highlight the key features of Excel that are used when modelling, including both Excel 2003 and Excel 2007.

1 • Introduction to valuation

An Investment Banking perspective

From an investment banker's perspective, valuation is performed for a number of different reasons. These reasons will often differ from the per share valuations that occupy equity investors, the focus of published equity research.

The key reasons investment bankers are interested in valuation are:

- **Mergers and Acquisitions**

The target company is valued by the acquirer. There are numerous techniques for performing this valuation, but, in essence, the aim is to determine a fair value for the operations of the target business.

- **Demergers and spin offs**

A business unit is valued independently of the parent (which itself may be listed).

- **Private equity valuations**

This involves valuation of the company for a private equity transaction. The target company could currently be listed and be taken private or it could be an unlisted company.

- **Initial Public Offer (IPO)**

In this instance the investment banker's perspective is closer to that of the equity research analyst in that the target audience for the valuation is the general investment community. However the techniques for valuing a newly listed company will differ from those used for valuing existing quoted securities.

Mergers and acquisitions

Rothschild will act on both the buy and sell side of M&A transactions. In each instance a number of different valuation techniques will be employed to derive a range of values which will form the basis for negotiation between buyer and seller.

Acting on the buy side

Objectives:

- To advise the acquiring company on the range of values for the target and the likely impact of paying those values on the acquirer's EPS, internal rate of return and other metrics
- To assist the directors of the acquiring company whose duty it is to consider the impact of the acquisition on shareholder value.

The target company is usually valued as a standalone entity. This means that valuing the earnings (usually based on a comparable multiple such as EV / EBITDA) or cash flows (Discounted Cash Flow or DCF techniques) of the target, assuming any growth is organic. Standalone valuation does not take into account the impact of future acquisitions by the target nor interference by the buyer (i.e. no synergies).

If the buyer is using listed company information to value a private company the buyer will push for a discount to take account of the illiquidity of the private company compared to quoted comparables.

Any potential synergies from the combination will be appraised separately and may form part of the overall valuation.

It is then usual to look at previous transactions in the sector and to consider the premia paid by other acquiring companies over the 'normal' valuation multiple for the targets they have acquired. This will give the buyer the price the target's owners will be 'expecting' as a return for selling the business (this will usually include the 'control premium', the compensation for passing over control of the business).

The next technique employed will usually be an LBO valuation. Based on the returns required by private equity (say 25% p.a.) it is possible to work out the maximum price which could be paid and still achieve this return. This will provide an indication of the likely amount to be offered by the private equity buyers in any auction.

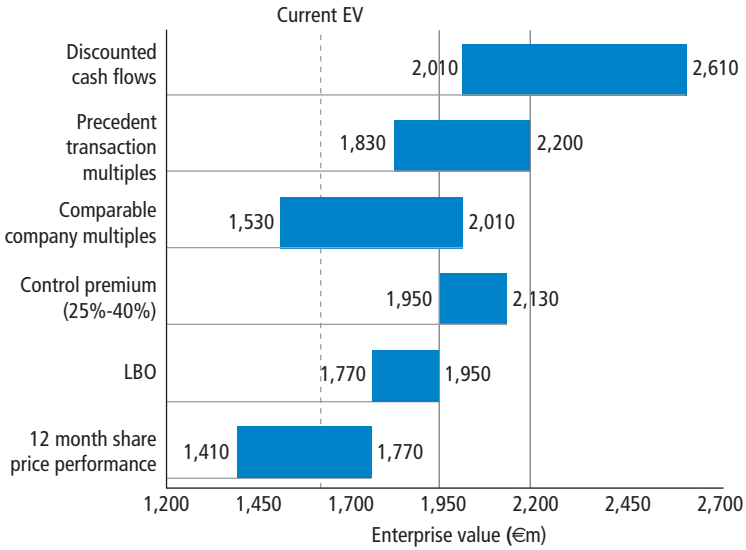
Trial capital structures will be input based on the lending constraints of the period.

If the structures are robust (loan repayment terms met, borrowing limits not exceeded) then the returns to equity can be checked.

If the returns are acceptable then the bid premia input into the model can be converted to a valuation and used as a benchmark on the football pitch.

The output of all of this valuation work is the "*Football Pitch*".

Summary valuation (€m)



The merger model

With a suitable range of potential values for the target company, the next stage is to run the merger model. This will make use of the potential purchase price (based on the above valuation range) and produce a combined EPS (this is most relevant for listed buyers) for the new entity. The model will take into account the financing of the acquisition together with the forecast synergies.

Ideally, the transaction should be EPS enhancing (accretive) rather than dilutive. The accretion (based on forecast numbers) is often seen in the year following the acquisition (or the year at which full synergies have been attained) – given the disruption in the year of acquisition and integration required.

The merger model will, in taking account of the financing of the transaction through cash or equity (or both), forecast the credit rating of the new

combination based on a new capital structure which may be very relevant for some sectors, but not a key part of analysis for other sectors.

Acting on the sell side / defence

The bank's role can vary here, Rothschild may be:

1. Acting for the seller in a private auction

Objectives
To help secure the best price and to maximise deal certainty.

2. Acting for the seller in a public takeover

Objectives
To help secure the best price and to maximise deal certainty.

3. Acting for the defence in a public takeover

Objectives
To help defend the target against an unwelcome predator.

In all three instances the valuation techniques discussed above will be employed. The valuations will be based on management forecasts, with estimates made for potential synergies and for private equity capital structures.

The valuations will be used to appraise the fairness of the buyer's bid price and to give shareholders an indication as to whether or not to accept the offer.

Demergers and spin offs

The valuation of a division is similar to valuing a private company although there may be publicly available information from equity research analysts who have valued the entire company on a sum of the parts basis, showing an implied value for the division in question.

The demerger will usually result in the listing of the division in question, with forecast numbers being produced by management. The main techniques of DCF and comparable company analysis should provide the basis for valuation.

Private equity valuation

The private equity buyer will be seeking a return of 25%-30% on the investment. The purchase will be highly leveraged with the aim of paying off the debt burden through the cash flow generation of the target company. The target will be valued using an LBO (leveraged buyout) model.

The model will trial differing capital structures with various constraints placed on the level of debt introduced (minimum equity component, 'Senior A' debt paid back after 7 years, etc.).

If the target can service the debt and the return to the private equity fund is in the region of 25% then the transaction may be viable.

IPO valuation

The flotation of a company will generally involve a bookbuilt marketing process. This is a two week period when the investment bank goes on the road with the company, meeting many leading institutional investors. During this period the valuation methodology will be outlined (comparable companies, Dividend Discount Model, etc.) and the market appetite for the shares will be assessed. The equity sales team will be in constant dialogue with the investors and the final price will be determined as a result of the demand for the stock.

Some common pitfalls

The following is a quick run through some of the valuation aspects that can trip up the unwary. It is an anecdotal section based on many years experience of reviewing valuations prepared in practice and / or simulations.

Seeing the big picture

Occasionally, analysts will become absorbed in the detail and produce final valuations that simply don't make sense. It is vital to step back from the detail and look at the final position, particularly with regard to inconsistencies that can arise as different parties produce different parts of the football pitch.

Watch out for:

1. Inconsistent net debt numbers between comps and DCF
2. EBIT numbers in comps and DCF that don't tie up with one another
3. Football pitches that confuse equity and enterprise value
4. Lack of reference to the current share price of the target on the football pitch
5. Bid premia in the merger model that don't tie in to the football pitch
6. Different seasonalisation of financials between methodologies
7. EV adjustments.

DCF

It is a well known cliché that the DCF model will not produce a 'right' answer – however there can be major inconsistencies in models which can undermine the integrity of the entire valuation.

Watch out for:

1. Timing of cash flows – be careful with the first period, especially if not a full year
2. Capex – think carefully about maintenance and expansionary capex and their relationship with growth
3. Tax – follow the tax calculations through the model (e.g. if Income from JVs is excluded from FCF what is the impact of the tax on this income?)

4. Tax rates – if the company is paying an effective tax rate which is less than the country rate, consider the impact on both cash flows and the cost of debt – should the rate eventually be the same for both?
5. Net debt – this will feature as a part of the WACC calculation (target leverage), part of the synthetic beta calculation (target leverage) and as part of the conversion from enterprise to equity value calculation. There should be some reconciliation between these numbers
6. Synergies – generally the target is valued as a standalone entity; synergies would not be part of the DCF
7. Synergies – occasionally these are valued in a DCF **as a separate calculation** – it is conventional to discount these at the acquirer's WACC
8. Terminal growth rates – whilst growth rates from year 10 onwards are a guess, it is important to cross reference them to reinvestment levels and to historic growth rates
9. Exit multiples – it is important that the implicit growth rates in the multiples are made explicit and sense checked
10. Mid-year discounting and the terminal value – for the exit multiple approach, use end-of-year discounting (assuming the company is sold on that date), for the perpetuity growth approach continue with mid-year discounting
11. Normalised FCF (capex = depreciation) and tax.

Comparable company analysis

Valuing a target using traded comparables will provide a market based benchmark, without any built in acquisition premium. The comps models are detailed and rigorous, but it is still possible to create confusion in the valuation.

Watch out for:

1. Adding an arbitrary premium (30% control) to the valuation without any explanation. The range on the football pitch should have a transparent audit trail and if possible should be presented without amendments
2. Ranges – too wide a valuation range is unhelpful
3. Models not kept up to date with most recent information. Update comps regularly for:

- Daily share prices
- Earnings announcements
- Corporate events such as M&A deals, share issues, buybacks

Keep source documentation for verification purposes

Make notes in the comps model to back up source information and adjustments made to historic and broker information

4. Financials not adjusted for exceptional items
   - Exceptional items are not just what the financial statements disclose as exceptional. Analysts should be able to make a judgment call on whether an exceptional item is truly exceptional or not (and conversely whether an item not disclosed as exceptional should be treated as such)
5. Ignorance of different GAAPs
   - Financials will need to be adjusted to a consistent set of accounting rules
6. Companies with different year ends not calendarised
7. Foreign currency figures not converted to a common currency
8. Corporate actions taken since the publication of the most recent set of financial statements. Always check regulatory filings and reflect this in the comps numbers
9. Blindly using broker numbers without understanding the definitions they have applied and ensuring that historics and broker information are consistent
   - Always reconcile the broker historicals to the published historicals – this will help to understand how the broker has defined key metrics e.g. EBITA and EPS, so that the historics and the forecasts can be input using consistent adjustments
10. The free float figure not being adjusted for significant shareholdings

Other things to bear in mind:

11. Understand the industry by reading analyst reports and news stories
    - What are the industry specific statistics (sales / employee, etc.)?
    - What are the most important performance ratios?
    - What are the most important market multiples?
12. Select the universe of comparable companies carefully – more is not necessarily better
13. Use only the most appropriate brokers
    - Ensure that the research is recent and subsequent to any company result announcements
    - Ensure that the forecast numbers are similar to global estimates
    - The recommendation is to use a consensus
14. All source documentation should be marked to show from where information has been extracted with both a post-it showing the page and a highlighter showing the numbers used
15. Use footnotes
    - To disclose adjustments made to the numbers
    - To explain unusual operating and financial trends
16. Ensure that the numbers are comparable – potentially, the more adjustments made for special situations (true exceptionals / non-recurring items, dilution, associates, etc.), the more comparable, but the more time to input the comps
    - The less likely that all the desired adjustments will be visible in the brokers' research forecasts
    - The more chance of errors
17. Keep the comps analysis up to date
    - Check the web site and the financial calendar of the individual companies to ensure that the most recent published financial information is used
    - Update share prices
    - Update exchange rates

18. Check the work
    - Double check for data entry or other processing mistakes
    - Step back and look at the finished product – do the results make sense?
    - Get someone else to check the work
19. Understand the results of the analysis and be prepared to discuss them. The numbers can be meaningless without solid analysis to back up the metrics
20. The comps model will calculate average metrics and multiples for the comparable universe. Do not just rely on using an average for the target company valuation
    - Review the comparables and exclude outliers from any average calculations. Make sure there is justification for using a comparable multiple that is above or below the average (mean or median).

Precedent transactions

The precedent transactions databases are notoriously unfriendly to users and care must be exercised in establishing the real transaction multiples. When the groundwork has been done and the valuations prepared there is still scope for error.

Watch out for:

1. Blind reliance on numbers taken from databases without reference to the original source data
2. Not spending enough time ensuring that the comparable universe is comparable – this can be frustrating but again you cannot necessarily rely on the data provider
3. Insufficient footnoting of assumptions or unusual data items
4. Premia incorrectly calculated (this is a common occurrence). It is vital to track back to the date before any rumours hit the market in order to accurately calculate the actual premium paid on the transaction
5. Inconsistent use of different accounting regimes – US GAAP vs. IFRS as with the comparable company analysis
6. Financials not adjusted for exceptional items – accounting or analyst viewed exceptionals

7. Transaction values not equal to the enterprise and equity value (<100% deals) – this needs to be adjusted very carefully
8. In addition, data providers such as FactSet and Bloomberg backdate share splits and rights issues to historical share prices so that share price graphs do not show jumps. It is essential to request 'unadjusted' share price date from these providers when analysing bid premia.

Accretion / dilution analysis

Once a valuation range is established this is input (often as a set of premia to the current share price) into a merger (or combination) model in order to do combination analysis.

The two main outputs of the model are EPS for the combination and an estimated revised credit rating. These are the key outputs of the valuation process and errors at this stage can be extremely painful.

The above is listed company focussed. Note: Credit ratings not important for smaller / mid cap companies although debt metrics such as net debt / EBITDA or interest cover would be assessed.

A valuation is of course an evolving, imperfect entity – but handled with care and consistency a robust and trustworthy outcome can be achieved.

2 • Comparable company analysis

Introduction

The objective of discounted cash flow modelling is to find the value of a company by analysing its cash flow characteristics, growth and risk profiles. Comparable company analysis (also known as "comps", "trading comps" or "Co Co" analysis) attempts to value companies based on how similar companies are priced currently in the market.

Why use comps?

Analysing the operating and equity market valuation characteristics of a set of comparable companies with similar operating, financial and ownership profiles provides a number of potential benefits:

1. An understanding of the key operating and financial statistics of the target's industry group (e.g. growth rates, margin trends, capital spending requirements). This information can be helpful in developing assumptions for a discounted cash flow analysis
2. An indication of relative valuation of publicly listed companies. The resulting multiples guide the user as to the market's perception of the growth and profitability prospects of the companies making up the group. Consequently, comps can be used to gauge if a publicly traded company is over or undervalued relative to its peers
3. A benchmark valuation for target entities. Comps valuations are based on:
   - Metrics of the target company (e.g. EBITDA), and
   - Multiples of similar quoted company(ies) (e.g. EV / EBITDA)

For example:

- Metric of target – earnings $10.0m
- Multiple of similar quoted company P/E 18.0x
- Theoretical equity value of target $10.0m x 18.0 = $180.0m

4. An indicative market price for a company which is to be floated on the stock market
5. The validity (or otherwise) of terminal DCF assumptions
6. Indicative investment returns for financial buyers acquiring assets in the public equity market in an IPO.

Reasons for popularity

Comps are widely used within Investment Banking and research. There are a number of key reasons for this:

- The valuation of a company using comps requires far fewer explicit assumptions and can be completed quickly relative to performing a full discounted cash flow valuation
- Comps are simpler to understand and therefore much easier to present to clients. There is no necessity for the client to have a firm grasp of financial maths or a deep understanding of the derivation of a company's cost of capital
- Comps are "real". The valuation technique is based on current market information and so should reflect the current mood of the market.

Potential pitfall areas

The ease of using comps and its reliance on a few key inputs are its strengths; these few key inputs also present certain weaknesses:

- The ease of pulling together the information to perform comps can result in inconsistent estimates where key variables such as risk, growth or cash flow profiles are ignored. The perceived ease of comps valuation can lead to a slack approach to the nuances of comps; this will be highlighted later on in this section. Consistency within comps will be a continuing theme throughout this section
- Comps should reflect the current mood of the market – this has just been mentioned as a strength. However, this suggests that using comps to value companies can result in valuations that are too high when the market is overvaluing comparable companies, as well as valuations that are too low when the market is undervaluing these comparable companies.
  Do remember that the valuation technique is attempting to measure a relative value, not an intrinsic valuation.

- There is scope for bias with any valuation method used to value a company. A major issue with comps is the lack of transparency in the valuation with respect to the underlying assumptions. An analyst can manipulate a valuation through the choice of the comparable universe or the metric used. This ability to choose 'appropriate' variables can be used to justify almost any valuation. On the same lines, stating that a company is valued on a P/E multiple of 12.0x does not give an insight into the risk, cash or growth profile of the business in isolation. The benefit of discounted cash flow valuation, despite its additional technical complications, is that the full valuation is justified from the bottom up – i.e. the cash flows that support the valuation are built up from the core drivers of the business. A comps valuation does not explicitly provide this information to support its valuation.

Structured approach to comps

The four steps outlined below provide a structured approach to using comps wisely, as well as for reviewing the preparation of comps by others.

Step 1 Identify the comparable universe of companies

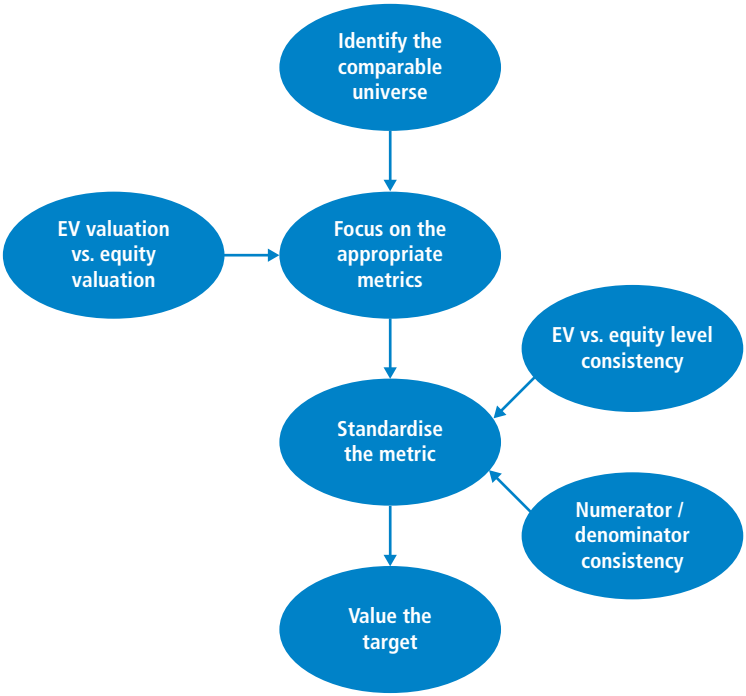
Step 2 Focus on the appropriate financial metrics and ratios

Step 3 Standardise the metric to ensure comparability and

Calculate the comparable multiple

Step 4 Value the target

Output – a pure market driven valuation excluding the value of a control premium



Step 1 is to identify the comparable universe of companies, ensuring that the initial sample of comparable companies used to value the target

is appropriate and the best sample of comparable companies from the available population.

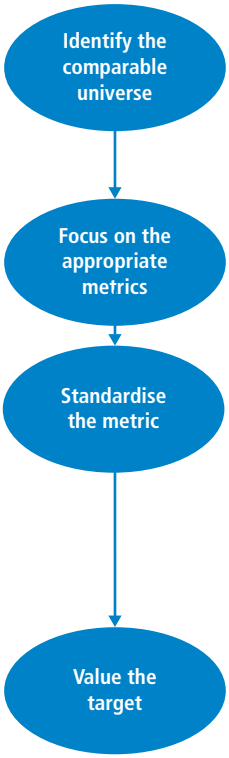
Steps 2 and 3 take an analyst through the choice of which multiple is the most appropriate to value the target company and ensures that the multiple is consistently prepared. Analysts have a myriad of choices open to them at this point:

- Should the multiple be at the equity level or the enterprise level?
- Which profit metric should be used in the multiple?
- Should it be a profit metric?
- Is this profit level consistent with the valuation approach being adopted? e.g. an EV valuation will require a pre-interest profit number
- Are the denominator and numerator in the multiple consistent across the comparable universe?
- Should we be using an earnings profit multiple or would a sector specific multiple be more appropriate (e.g. EV / bed, EV / subscriber...)?

Step 4 takes the analyst through to the valuation of the target company. Once the comparable universe and the multiples have been prepared and made consistent, a decision must be made as to the final multiple to be applied in the target valuation.

An overview of the comps process

As we mentioned earlier, comparable company analysis attempts to value companies based on how similar assets are priced currently in the market. We will use a traditional P/E approach to illustrate the process (although EV / EBITDA is more commonly used within IB).



Step 1 – Identify the comparable universe
Target company:
easyJet
Comparable universe:
Ryanair
AirAsia
Jetstar
Virgin Blue

Step 2 – Focus on the appropriate metric
Equity valuation
Use a PE ratio

Step 3 – Standardise the metric
Calculate PE multiples for 4 comparable companies

	PE multiples (Forward)
Ryanair	17.2x
AirAsia	18.0x
Jetstar	15.0x
Virgin Blue	17.0x
Average	**16.8x**

Step 4 – Value the target
Using an average multiple of 16.8x earnings to value easyJet

Comparable PE	16.8x
easyJet forward EPS (p)	37.5
Implied equity value (p)	**630.00**

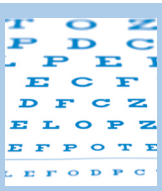
Step 1 – Identify the comparable universe

The above illustration is attempting to value an equity share of easyJet plc, using comparable company analysis. The first step is to select a comparable universe of companies that will be used to value the target company, easyJet plc. The selection of an appropriate comparable universe is the cornerstone of comps. The detail on how a comparable universe is selected is covered in the following section of this manual. Suffice to say,

the comparable universe should contain companies that display similar characteristics to easyJet plc. This universe will be used to derive a valuation for easyJet plc based on how the universe is priced currently in the market.

For the purposes of this example, the comparable universe has been identified as:

- Ryanair
- AirAsia
- Jetstar
- Virgin Blue.



Checkpoint – Choosing the comparable universe

Choose an inappropriate universe and the valuation will be flawed – poor sample ➔ poor valuation.

Step 2 – Focus on the appropriate metric

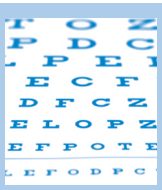
Comps analysis can value companies at the equity level as well as at the enterprise level. This example illustrates an equity level valuation of easyJet using comparable P/E multiples.

Step 3 – Standardise the metric

Step 3 involves calculating P/E multiples for the comparable companies. It is vital that the multiples are calculated in a consistent manner across the sample. Otherwise, differences in the calculations will introduce "noise" into the valuation. For instance, the P/E multiples were all calculated using forward earnings estimates. This must be done consistently across the sample. A comparable universe where the multiples have been calculated using a mixture of forward, current and trailing earnings numbers is of little use.

	PE multiples (Forward)
Ryanair	17.2x
AirAsia	18.0x
Jetstar	15.0x
Virgin Blue	17.0x
Average	**16.8x**

Once we have a consistent set of comparable multiples, the target can be valued.



Checkpoint – The issue of consistency

Consistency is **THE** key concept that needs to be reinforced throughout the comps process. Inconsistent comparable companies and calculations will lead to an incorrect valuation.

N.B.: As well as standardising for period of earnings, also **calendarise** for different year / ends.

Step 4 – Valuing the target company

Once there is a well defined comparable universe along with a set of consistently calculated multiples, the target company can be valued. A crucial decision is the size of the multiple to use to value the target company, easyJet plc. The comparable universe provides P/E multiples ranging from 15.0x to 18.0x earnings, with an average 16.8x. easyJet plc could be valued by applying any of these multiples to its own earnings number. Clearly, the choice of a multiple between 15.0x and 18.0x will have a material impact on the implied equity valuation.

A key decision of the analyst will be to decide what size of multiple will be appropriate to value easyJet plc. The decision is not as simple as plumping for the average. Using the average as the comparable multiple to value easyJet plc is implying easyJet plc would be an average company within the comparable universe and therefore valued at a premium to those trading below the average P/E and at a discount to those trading above the average P/E.

The analyst may believe, because of his or her knowledge of the company and the circumstances surrounding the valuation, that easyJet plc should be valued using a comparable multiple at a premium or a discount to the average of the comparable universe. This is a judgement call based on experience, knowledge and skill, backed up by appropriate analysis e.g.:

- Review of sector Key Performance Indicators (KPIs)
- Quality of assets, brand, etc. relative to industry peers.

Using an average multiple of 16.8x earnings

to value easyJet	
Comparable PE	16.8x
easyJet forecast EPS (p)	37.5
Average	**630.00**

Once the appropriate comparable multiple has been determined, the target can be valued. A comparable multiple applied to an EPS number will produce an implied equity value per share. The same multiple applied to an earnings number will produce an implied total equity value.

Checkpoint – The issue of consistency – again

Consistency is again an issue. As the comparable multiples are forward PE multiples, the EPS used to produce the implied equity value per share must be a forward EPS estimate.

Step 1 – Identify the comparable universe of companies

Comps valuation requires in-depth understanding of the target company and its peers. Comps valuation multiples will only be useful if the companies in the comparable universe are truly comparable. A comparable company is one with cash flows, growth potential and risk characteristics similar to the firm being valued. Furthermore, a comparable company may not be in the same sector as the target company. For example, a telecoms firm could be included in the comparable universe used to value a software company, if the cash, risk and growth profiles were comparable.

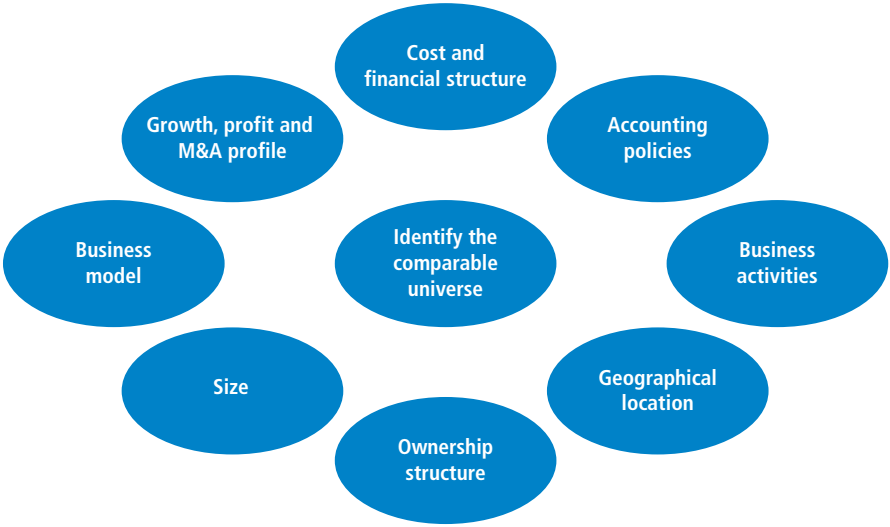
As no two companies are exactly the same, the most similar companies are sought.

The companies (both target and comparable) should have similar:

- Business activities – industry, products and distribution channels
- Geographical location
- Size (turnover / market capitalisation)
- Business model
- Growth profiles (including growth prospects, seasonality and cyclicality)
- M&A profiles
- Profitability profiles
- Cost structure
- Capital structure (including the credit rating)
- Ownership structure (including the free float)
- Accounting policies (the accounting rules that the company follows)
- Market liquidity of the securities
- Breadth of research coverage.

Often, it is only when data is collected on a wide range of companies (including the target) and calculations performed on the numerical aspects above (e.g. profitability, historic growth etc.) that it becomes clear which companies are truly comparable with the target.

If equity level comps are to be used, similar capital structures are essential.



Checkpoint – Choosing the comparable universe

Select the universe of comparable companies carefully – more is not necessarily better.

Step 2 – Focus on the appropriate financial metrics and ratios

Multiples are easy to use and easy to misuse. Having identified what is believed to be an appropriate comparable universe, comparable multiples must be calculated.

The following questions must be answered at this stage:

- What level of valuation are we seeking – equity or enterprise value level?
- Which profit metric should be used?

What level of valuation are we seeking – equity or enterprise value level?

Equity value multiples

When valuing a company the primary concern is whether the equity in a company is fairly priced, or what price to pay for the equity of a target. It seems to follow logically that we should look at equity multiples, where we relate the market value of equity to the earnings of the company – the price earnings (P/E) ratio.

Why is the P/E ratio used so widely?

- It is an intuitively appealing statistic that relates the price paid to current earnings
- It is simple to compute for most listed companies, and is widely available, making comparisons across listed companies simple
- It is a proxy for a number of other characteristics of the firm including risk and growth.

Potential for misuse

- The earnings used in the calculation of P/E ratios is an accounting number sourced from the very bottom of the income statement.
  This number is open to numerous creative accounting issues, such as when to recognise revenues and costs, as well as accounting policy choices in relation to depreciation and amortisation
- Because the earnings measure is post interest, the metric is capital structure dependent. This may reduce the number of comparable companies because, to be truly comparable, the company needs to have a similar capital structure.

	Pros	Cons
P/E	• Widely used in traditional industries with high visibility of earnings • Widely understood • Quick and easy calculation.	✘ Depends on capital structure ✘ Accounting policies have a significant impact on earnings.

Enterprise value multiples (EV multiples)

While equity multiples focus on the value of equity, enterprise value multiples are concerned with valuing the entire company or its operating assets. Potentially, this will increase the number of comparable companies, since it is not dependant upon capital structure.

Enterprise value represents the entire economic value of a company. From a trading EV, one can estimate a theoretical take-out EV (incorporating the likely offer premium).

From an Investment Banking perspective this is a more useful measure, as the valuation needs to consider the total financing requirement needed to take over the target company.

Enterprise value (in its basic form ignoring associates and JVs – addressed on page 50) is calculated as follows:

Enterprise value = Equity value + Net debt + Minority interest

The conventional measure of enterprise value is obtained by adding the market value of equity to the market value of debt. However, this enterprise value measure includes all assets owned by the firm including its cash holdings. Deducting the cash from the debt value produces the 'net debt' and yields an enterprise value that can be considered to be the market value of the operating assets of the firm.

An alternative way to view this is that it is the financing required to fund the operating assets of the firm.

For example:

		Tesco	
Share price (p)	261.5		
Number of shares (m)	6,932		
Equity value (£m)		**18,127**	**[A]**
ST debt	1,413		[B]
LT debt	1,925		[C]
Cash & cash equivalents (liquid resources)	(534)		[D]
Net debt		2,804	[E] =[B+C+D]
Minority interest		36	[F]
Enterprise value (£m)		**20,967**	[A +E + F]

Market capitalisation (measuring equity value)

With publicly traded firms, measuring the market value of equity is a relatively simple exercise. This simple exercise however can become complicated due to:

- Terminology associated with the number of outstanding shares
- The existence of share options.

Terminology

Obviously, the correct number of shares needs to be used to calculate the market capitalisation for multiples calculations. The financial statements will disclose a variety of share numbers. It is vital that analysts understand and appreciate the different 'number of share' definitions. The following terminology is commonly used:

- Authorised number of shares
- Issued number of shares
- Outstanding number of shares
- Outstanding number of shares for public market valuation.

Authorised number of shares	Issued number of shares	Outstanding shares	Outstanding shares for public market valuation
Number of shares that could be issued, though some not yet issued	Shares issued	Shares issued and outstanding (excludes treasury stock)	Shares issued and outstanding (including potentially dilutive securities)

Share options

When calculating equity value, the total market value of equity should include the value of equity options issued by the firm, including non-traded management options. If the objective is to estimate how much should be paid for a company, this must include the value of equity options.

When calculating the market capitalisation, the most up to date outstanding number of shares should be used unless the fully diluted share capital is materially more, in which case the treasury method should be used for calculating the fully diluted number of shares.

The treasury method will be used when the company has:

- A large number of share options and/or
- The exercise price is significantly lower then the current market price.

The treasury method assumes that the proceeds from the exercise of the options are used to buy-back shares at the current share price.

Illustration

Current share price	**120p**
Outstanding number of shares	**5.0m**
Options outstanding	**1.0m**
Exercise price	**40p**

Outstanding number of shares	5.00m
Options outstanding	1.00m
Full price shares from proceeds [(1.0m x 40p) / 120p]	(0.33m)
Net dilution	0.67m
Fully diluted number of shares	5.67m
Dilution as a % of the outstanding number of shares	**13.3%**

Regulatory news services should be reviewed to establish the extent to which the company has issued or adjusted its share capital since the last set of financial statements.

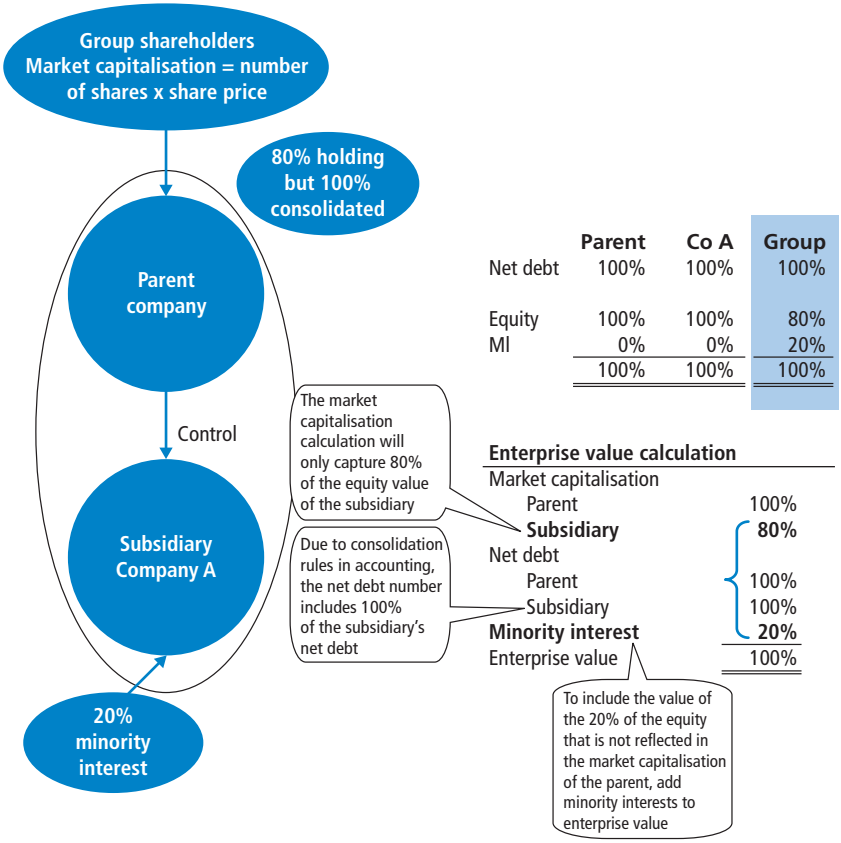
Minority interests

Minority interests will need to be considered when establishing the enterprise value of a company with controlling holdings in other companies.

If a parent company holds, say, 80% of a subsidiary, it is required to fully consolidate its financial statements. As a consequence, the debt and cash that are used to compute enterprise value include 100% of the cash and debt of the subsidiary (rather than just the 80%) but the market value of equity only reflects the 80% holding. To establish the value of 100% of the operating assets of the firm it is necessary to bring in the value of the remaining 20%, called the minority interests. This is the value of the 20% controlled but not owned by the shareholders of the parent company.

Enterprise values should be measured using the market value of all its components. Minorities are a constituent part of enterprise value and should, when representing a significant value, be valued at market value. Otherwise they should be included at book value. Where the subsidiary in which the minority arises is quoted, the market value of the minority can be established easily.

Practical difficulties in arriving at the market value of minorities exist where the subsidiary in which the minority arises is unquoted. Unquoted minorities will have to be valued on a separate basis, using the valuation techniques discussed in this manual.



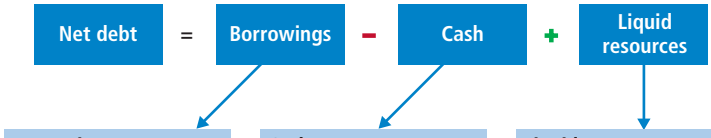
	Parent	Co A	Group
Net debt	100%	100%	100%
Equity	100%	100%	80%
MI	0%	0%	20%
	100%	100%	100%

Enterprise value calculation

Market capitalisation	
Parent	100%
Subsidiary	**80%**
Net debt	
Parent	100%
Subsidiary	100%
Minority interest	**20%**
Enterprise value	100%

Net debt

Basic net debt is defined as:



Borrowings =
instruments issued as a means of raising finance other than those classified in / as shareholders' funds
+ Related derivatives
+ Obligations under finance leases

Cash =
cash in hand
+ Deposits repayable **on demand** with any qualifying financial institution
– Overdrafts from any qualifying financial institution repayable on demand

Liquid resources =
current asset investments held as **readily disposable** stores of value

On demand =
can be withdrawn at any time without notice and without penalty (or where maturity or period of notice of not more than one working day has been agreed in advance)

restricted cash balances are not readily disposable so should not be included in net debt

Readily disposable =
disposable without curtailing or disrupting business of the reporting entity and either
- Readily convertible into known amounts of cash at or close to its carrying amount or
- Traded in an **active market**

Active market =
a market of sufficient depth to absorb the investment without a significant effect on the price

Some analysts adjust the net debt portion of this formula for:

- Preferred shares. Despite falling outside the above definition, preference share capital may be included within net debt for analysis purposes as it has many of the attributes of borrowings without meeting the definitional and legal requirements of borrowings

- Market value adjustments. This will vary depending on the sector and team but generally preference shares and quoted debt would not be marked to market if the difference between market value and book value was not significant. When a company is in financial distress, debt instruments should be marked to market.

This information should be readily available for traded debt and preference share capital. Additionally in some jurisdictions, the company may disclose this information.

For example, IAS 32 requires market values to be disclosed for all financial instruments. This will be the value as at the last balance sheet date which will need to be updated for current valuations.

- The present value of operating lease commitments (see later notes)
- Defined benefit pension scheme deficits (see later notes)
- Non-operating cash balances within the net debt / (cash) balance.

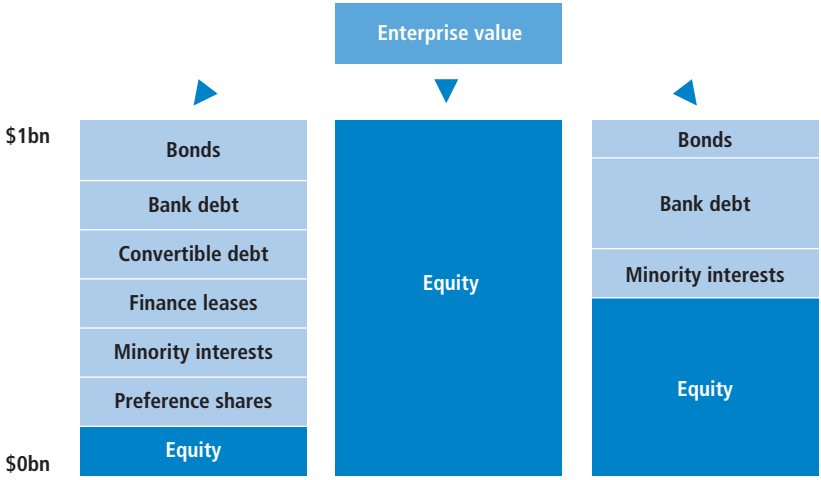
Non-operating cash balances

Some analysts draw a distinction between operating cash and excess cash, with only excess cash being subtracted in calculating net debt, and hence enterprise value. This can be a subjective adjustment due to the lack of available information, although drawing a distinction between operating and non-operating cash is valid.

Why does enterprise value matter?

When attempting to gauge the overall value assigned to a firm, some investors look exclusively at market capitalisation. However, in most cases this is not an accurate reflection of a company's true value. Enterprise value considers much more than just the value of a company's outstanding equity.

The enterprise value is made up of the different elements of the capital structure adopted by a company to finance the operations of the company. The way this EV is then used in comps is independent of this capital structure. For example, a company may have an enterprise value of $1bn; this could be made up in a variety of ways, and only if it is solely equity will enterprise value = market capitalisation:



More specifically, enterprise value considers the fact that an acquirer must also bear the cost of assuming the acquired company's debt. Additionally, enterprise value incorporates the fact that the acquirer would also benefit from the acquired company's cash. This cash would effectively reduce the cost of acquiring the company.

Debt and cash can have an enormous impact on a particular company's enterprise value. For this reason, two companies may have the same market capitalisation but may have very different enterprise values.

The media, the City, and major corporations often cite various valuation measures – such as P/E ratios – without mentioning the impact of debt obligations and cash. However, at times this can be very misleading, as ratios like P/E multiples do not take cash and debt into consideration. The reason for this is simple – the "price" in these ratios reflects only the value of a firm's equity.

To get a better sense of a company's true valuation, many analysts and investors prefer to compare profits, sales, and other measures to enterprise value.

EV / EBITDA multiples

EV / EBITDA is a firm or enterprise value multiple. Over time, this multiple has gained in popularity for a number of reasons:

- There are far fewer firms with negative EBITDA than there are firms with negative earnings. Thus fewer firms are lost in the identification of the comparable universe
- There are significant differences in depreciation policy between firms in the same sectors as well as across borders that cause significant differences in operating profit and net income. Using EBITDA as a metric ensures that the multiple is unaffected by the depreciation policy choice of the comparable company
- The EBITDA metric used in the multiple is above the interest line in the income statement, so is regarded as being capital structure neutral. This means that the multiple can be compared far more easily than other earnings multiples across firms with different financial leverage, as the numerator is enterprise value and the denominator is a pre-debt profit figure.

Understanding what drives EV / EBITDA multiples (EV multiple model)

The EV multiple model (one of the standard Rothschild models) returns estimated EV multiples and equity values on the basis of fundamental drivers of value:

- Growth rate in NOPAT (net operating profit after tax)
- NOPAT reinvestment rate (the proportion of NOPAT reinvested in further operating assets)
- Cost of equity and debt
- Target gearing – over each of the two stages of growth.

The model is a two stage model with a high growth visible period, say 10 years, and a second lower growth perpetuity period. It can be used to investigate the growth rates and multiples implicit in the existing EV ratios of the selected quoted company.

The key inputs on the control (in) sheet are payout ratio, WACC and growth in earnings: from these the company's "fair" enterprise value is calculated.

Key drivers	10-year visible period	Post visible period
Number of years in the period	10 years	11 – ∞ years
Growth rate in NOPAT	8.0%	2.5%
Reinvestment rate	55.0%	35.0%
Cost of equity	8.00%	7.5%
Post tax cost of debt	3.90%	4.00%
Net debt / EV ratio	15.1%	25.0%
WACC	7.38%	6.63%
Payout ratio	45.0%	65.0%
Visible period value (£m)	**7,884**	**29,034**

Outputs to be re-set using Goal Seek	
Equity valuation for Tesco	**£m**
Breakdown of enterprise value	
Enterprise value	36,918
Less: Net debt	(5,024)
Less: Minority interest	(65)
Add: JVs & associates	314
Implied equity value	32,143
Implied equity value per share (p)	**404.5**

Historic P&L and balance sheet data should be entered.

Historic multiples (year end 23 February 2007)	
EV / Sales	0.87x
EV / EBITA	15.2x
EV / EDITDA	11.2x

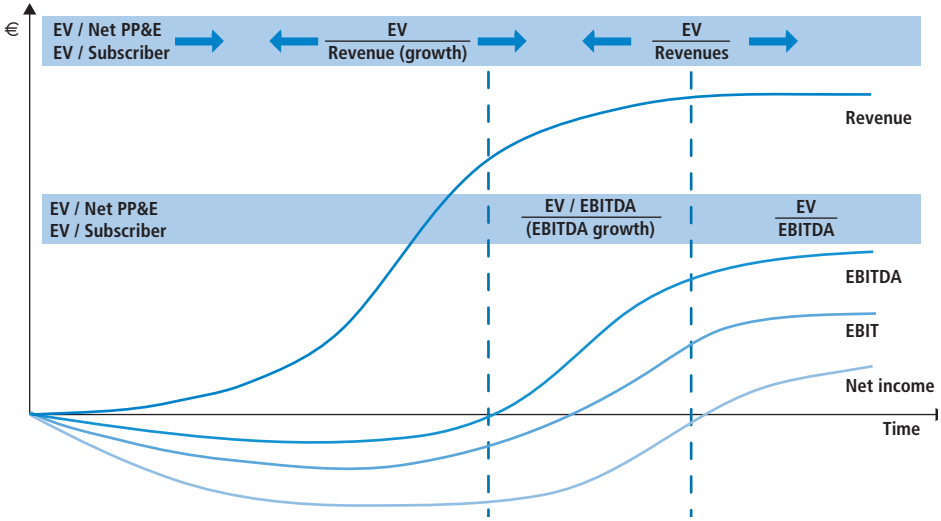
Source: Rothschild EV multiple model

Goal Seek within Excel can be used to justify a current market ratio by seeking a required level of performance from a key driver.

Which profit metric should be used?

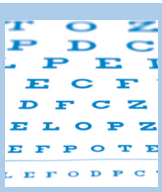
The relevance of the different valuation benchmarks changes over time as business models evolve. Consequently, two key questions must be asked when selecting multiples:

- What is the development stage of the target company relative to the comps?
- What is the appropriate comps universe trading on?



Multiple	Pros	Cons
EV / Sales	• Suitable for companies with similar business model / development stage • May be the only performance related multiple available for companies with negative EBITDA • Sectors where operating margins are broadly similar between companies • Companies whose profits have collapsed • Sectors where market share is important • Limited exposure to accounting differences	✘ Does not take into account varying revenue growth rates ✘ Does not address the quality of revenues ✘ Does not address profitability issues ✘ Inconsistency of treatment within sales of joint venture in different reporting environments ✘ Different revenue recognition rules between companies
EV / EBITDA	• Incorporates profitability • Most businesses are EBITDA positive so widening the universe • Relatively limited exposure to accounting differences	✘ Ignores depreciation / capex ✘ Ignores tax regimes and tax profiles ✘ Does not take into account varying EBITDA growth rates although we can growth adjust the multiples ✘ Inconsistency of treatment within EBITDA of joint venture and other unconsolidated affiliates within different reporting environments ✘ Other accounting differences such as revenue recognition, capitalisation policies, finance vs. operating leases

Multiple	Pros	Cons
EV / EBIT(A)	• Incorporates profitability • Useful for capital intensive businesses where depreciation is a true economic cost • Good for companies within the same reporting environment where accounting differences are minimised	✘ Depreciation / amortisation policies may differ ✘ Ignores tax regimes and tax profiles ✘ Does not take into account varying EBIT(A) growth rates ✘ Inconsistency of treatment within EBIT(A) of joint venture and other unconsolidated affiliates within different reporting environments ✘ Other accounting differences such as revenue recognition, capitalisation policies, finance vs. operating leases



Checkpoint – Picking the correct metric and multiple

By understanding the industry through reading analyst reports and news stories it will become clear:

- What are the most important performance ratios and market multiples to focus on
- Whether there are industry specific statistics (e.g. hotels – price per room).

Growth adjusted multiples

During the late 1990s growth adjusted multiples became a popular element of equity research. Essentially the standard multiple, for example the P/E ratio was simply divided by an estimate of the growth rate in the denominator.

For example a P/E 12 estimated growth in earnings 8% p.a. over the next 5 years.

P / E / G =12 / 8 = PEG ratio of 1.5

Similar calculations can be done with other ratios EV / EBITDA over forecast growth in EBITDA.

One of the initial reasons for creating the growth adjusted multiple was to assist with relative valuation in a period when the multiples (in particular the P/E multiples) were extremely high ie by dividing by growth rates (which were also forecast to be extremely high) the comparables became easier to work with.

The PEG ratio is determined by growth rates, risk and payout patterns in the same way as the traditional PER.

We can use one or two stage growth models and regression analysis to compare the implied growth adjusted multiple with the actual multiple for example with the PEG.

Expected PEG = a +b (growth rate) + c (risk) + d (payout ratio)

If the expected PEG from the above is greater than the actual PEG, the stock is possibly undervalued.

It is most important to be consistent with these multiples and especially to avoid double counting (i.e. if the estimate of growth in EPS is from the

current year it would be a mistake to use forward EPS in computing PER as we would be including this growth twice).

Sector specific metrics

Standard profit and revenue multiples can be calculated for most companies, in most sectors across the market. However, there are times when sector specific multiples are required. A good example of the emergence of sector specific multiples was the internet sector during the late 1990s.

The issue arising with using comps to value internet firms in the 1990s was that they generally had negative profits, negligible sales and weak balance sheets. Therefore the traditional metrics available in comps analysis really were inappropriate.

Analysts trying to value these companies started to develop multiples that attempted to link the value of the companies to non-financial value drivers. For instance, some analysts were valuing internet firms by dividing the market value by the number of hits generated by the firm's website. As e-tailers have developed over the last decade, e-bay being a good example, they are now being valued on a per customer basis.

Why do analysts use sector specific multiples?

There are several key reasons why analysts use sector specific multiples:

- They link the value of the company to the output and operations of the business. This is especially useful for analysts who will start the forecasting process from a micro level, for instance many internet analysts will start the forecasting process from predicting the number of subscribers
- Often the sector specific multiples are calculated without reference to accounting numbers. As accounting numbers can be easily manipulated, this bias does not seep into the multiple calculations. Also multiples can be calculated for companies or business segments where the accounting information is unreliable, non-existent or just not comparable. It's a lot easier to calculate the value per kwh for an African power company than having to worry about what GAAP its accounting numbers (if they are even prepared) are presented under
- Although not an advantage; sector specific multiples are often used out of desperation because no other multiples work or the information is just not available for the comparable companies.

Checkpoint – Dangers using sector specific multiples

Since sector specific multiples cannot be calculated for other sectors or for the entire market, these multiples, because of their isolated existence, can result in persistent over and under valuations of the sector in question relative to the rest of the market.

An investor that would never consider paying 80x earnings for a company, may be fooled into paying £1,500 per web hit, as it is very difficult to get a sense of relativity to the multiple.

Another danger is that it is difficult to relate sector specific multiples to the fundamental drivers of value of the company. How does a web-site hit translate into value? How do you forecast web-site hits?

Typical sector specific multiples

A number of multiples can be used, as illustrated below, but remember that EV / EBITDA is the most widely used multiple across the investment bank.

Sector	Multiples
Consumer brands	Equity value / net income
Energy and utilities	EV / reserves
Financial institutions	**Asset managers**
	EV / revenue
	EV / EBITDA
	EV / EBITA
	Price / Assets Under Management (AUM)
	Life insurance
	Price / embedded value
	Non life insurance
	Price / adjusted net assets
Industrials	**General**
	EV / EBITA
	Chemicals
	EV / Capex adjusted EBITDA
Real estate	**Property companies**
	EV / FFO
	EV / FAD (Funds available for distribution)
	Price / NAV
	Real Estate Investment Trusts (REITs)
	EV / FFO
	EV / FAD (Funds available for distribution)
	Dividend yield

Sector	Multiples
Metals and mining	**Gold mining**
	P / NPV
	EV / Reserves
	EV / Reserves and resources
	General mining
	EV or equity value / Production tonne p.a.
	Smelting
	EV or equity value / production tonne p.a.
	EV or equity value / capacity tonne p.a.
Media	**PayTV – Cable**
	EV / subscribers
	EV / homes passed
	PayTV – Satellite
	EV / subscribers
	Film exhibitions / theatres
	EV / total screens
	Broadcasting
	EV / broadcast cash flow
Telecoms	**Fixed**
	EV / EBITDA (a key metric)
	EV / (EBITDA – capex)
	Wireless
	EV / (EBITDA – capex)
	EV / subscribers

Sources of information

Information	Source
List of comparable companies	Sector brokers' reports Bloomberg Hoovers Prospectuses (often have a "Competition" section)
Share price	Datastream, Bloomberg, FactSet
Shares outstanding	Most recent annual report (or interim results or 10Q) updated for any subsequent changes – for UK companies see Regulatory News Service (RNS) for changes, Bloomberg
Options outstanding and exercise price of options	Most recent annual report (or, unusually, interim results or 10Q) updated for any subsequent changes reported Companies reporting under US GAAP will disclose the weighted average exercise price
Debt and cash	Most recent annual report or more recent interim results or 10Q
Preference shares	Most recent annual report or more recent interim results or 10Q
Minority interests	Most recent annual report or more recent interim results or 10Q (valuing at market value if possible)
Income statement information	Most recent annual report (or more recent interim results or 10Q if last 12 months [LTM] analysis is to be done)
Forecast financials	Broker research I/B/E/S database (the median of all estimates) FactSet uses Reuters consensus
General information	Extel cards and Datastream 101A

Checkpoint – Cover your back

- All source documentation should be marked to show where information has been extracted from, with both a Post-it showing the page and a highlighter showing the numbers used
- Footnotes should be used for all assumptions and points of interest
- When choosing a broker, make sure the numbers are sanity checked with Global Estimates to make sure the analyst's projections are in line with peers.

Step 3 – Standardise the metric to ensure comparability

Is the metric consistently defined?

Even the simplest multiples can be defined differently by different analysts. When calculating EV, market capitalisation is an important component – this should be a simple calculation. For most analysts it is simply the current share price multiplied by the outstanding number of shares.

However a number of variations of this market capitalisation calculation exist. Some analysts will use the latest closing price; other will use VWAPs (volume weighted average prices) for varying time periods.

VWAP is calculated by adding up the £s traded for every transaction (price multiplied by number of shares traded) and then dividing by the total shares traded for the day.

$$\text{VWAP} = \frac{\Sigma \text{ Number shares bought x share price}}{\text{Total shares bought}}$$

The profit metric has a number of variants. The denominator in these multiples (the earnings number) can be based on:

- The most recent financial year profit – providing a current year multiple
- The last 12 months (LTM) – providing a trailing LTM multiple
- The forecast period – providing a forecast multiple.

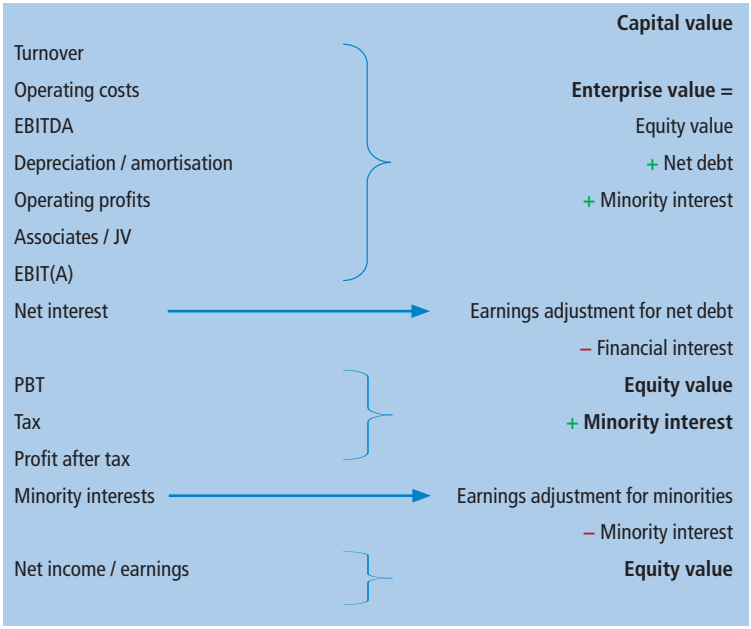
These variants can provide vastly differing multiples and hence valuations. Sometimes the variant that is used by analysts can by driven by bias. For example, during a period of rising profits, forward multiples might yield lower valuations than trailing multiples. Therefore the analyst's stand point as regards the valuation (maximise, minimise) will determine which variant of the profit metric the analyst uses.

Checkpoint – Metric consistency

- Make sure that the comparable multiples are calculated consistently. All metrics needs to be based on the same profits variants. That is, if using forward multiples, forecast numbers must be used for all comparable multiple calculations and for the target valuation.

Is the metric consistently calculated?

Every multiple has a numerator and denominator. The numerator is either equity or enterprise value. The denominator can either be an equity measure such as earnings per share or net income or an enterprise measure such as EBITA or EBITDA. If the numerator is enterprise value the denominator must be an enterprise value measure. One of the key issues with comps is trying to ensure that numerator and denominator are defined consistently.



Adjustments may be needed to the metrics and/or the resulting equity or enterprise value when the following issues arise in the target and/or the comparable company:

- Associates and joint ventures
- Pension scheme deficits
- Exceptional items
- Operating lease adjustments
- Currency differences
- Different year ends – annualisation

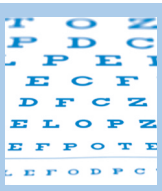
- LTM (last twelve months) issues
- Acquisition and disposals.

As mentioned on a number of occasions the overriding idea behind comps is to ensure that there are like-for-like comparisons. Consequently, if one of the companies in the comps universe has significant associates whilst its peers do not, then an inconsistency exists amongst the universe. The metrics of the company with the associates need to be adjusted to remove the inconsistency to ensure comparability.

Associates and joint ventures

Remember that minority interest needed to be added into the enterprise value calculation in order to ensure that the full equity value of the subsidiary was reflected. The market capitalisation calculation can give rise to another issue of consistency in an EV / EBITA or EV / EBITDA multiple due to associates and joint ventures.

When enterprise value is calculated for comparable multiple purposes, it is initially driven by the market capitalisation calculation. As discussed, the basic calculation is to multiply the outstanding number of shares (often adjusted for outstanding options) by the current share price. This value captures the equity value attributable to the group shareholders. This value should reflect the equity value derived from the group's investment in associates and joint ventures. An enterprise value calculation and therefore the numerator in an EV multiple includes the equity value of the associates and joint ventures.



$$\frac{\text{Enterprise value}}{\text{EBITDA}}$$

Enterprise value = Includes the equity value of joint ventures and associates

EBITDA = Excludes the profit contribution from joint ventures and associates

A potential inconsistency arises when the denominator in an EV multiple is EBITDA or similar metric. As the BA extract below illustrates, EBITDA excludes the profit contribution from joint ventures and associates, whilst the EV numerator includes the value from joint ventures and associates.

Group Consolidated income statement	
Historic financial year	
£m	
Traffic revenue	
Passenger	6,820
Cargo	498
	7,318
Other revenue (including fuel surcharges)	1,197
Revenue	**8,515**
Total expenditure on operations	7,810
Operating profit	**705**
Fuel derivative gains	19
Finance costs	(221)
Finance income	93
Financing income and expense revenues	(18)
Retranslation (charge) / credits on	(13)
Profit on sale of fixed assets and investments	27
Share of post-tax profits in associates accounted for using the equity method	28
Income relating to fixed asset investments	
Profit before tax for the year	**620**
Tax	(153)
Profit after tax for the year	**467**

The profit contribution from associates and joint ventures is brought in below the EBITA (operating profit) line.

Source: British Airways Annual Report

The numerator and denominator need to be made consistent. Normally the multiple is made consistent by stripping out the equity value of the joint ventures and associates from the EV calculation. This adjustment will often use the balance sheet book value of the associates and joint ventures. If the information is available or the value adjustment relating to joint ventures and associates is significant, the market values should be used. If the joint ventures and associates are listed, the market value adjustment will be a proportion of the entity's market capitalisation. The adjustment is more involved if the joint ventures and associates are unlisted. At this point, the analyst may consider completing a secondary valuation (comps or DCF) on the joint ventures and associates.

Pension scheme deficits

Where a business has guaranteed a minimum pension to employees on retirement, it must make payments into the pension scheme to meet these future obligations – a defined benefit scheme. These payments will be invested by the pension scheme with the intention of meeting the future pension requirements when they fall due. Over time, employees within the scheme will be getting closer to pensionable age and may also be entitled to greater pension payouts as they continue to work for the business.

Although fraught with difficulties and uncertainties it is possible to calculate the amount needed today to fund the future pensions of today's employees. This is called the present value of the defined benefit obligations. It follows that it is possible to calculate the pension deficit or surplus – the difference between the fair value of scheme assets and the present value of defined benefit obligations.

Pension costs

The assets and liabilities of the schemes at year end:

£m	Total
Scheme assets at fair value	
Equities	**4,261**
Bonds	**1,197**
Others	**692**
Fair value of scheme assets	6,150
Present value of defined benefit obligations	8,440
Net pension (liability) / asset	**(2,290)**

Source: British Airways Annual Report

In simple terms, if a business has not made sufficient payments to the pension scheme, then the scheme is likely to be in deficit. Comparable companies which have historically made sufficient cash payments into the scheme (no deficit) will consequently have larger net debts to companies with deficits. If the companies with deficits were to clear them using existing cash resources or by borrowing their net debts would increase.

The accounting for defined benefit pension schemes is notoriously complex and also depends on which accounting regime is followed. The detail of pension accounting is contained in the accounting manual. However, despite

the variants in the accounting, the true funded status of the pension scheme will always be disclosed in the notes to the accounts.

As payments into pension schemes are tax deductible, any payments made to reduce this deficit will reduce taxes payable. Consequently, assuming a corporate tax rate of 30%, the adjustment to net debt and therefore enterprise value, would be an extra £1,603m [£2,290m x (1-30%) – see the BA extract above] of "debt" to make it comparable to a business which has already made up any deficit. This would increase BA's net debt from £1,641m to £3,244m.

No adjustment should be made to net debt if the pension scheme has a surplus. The net asset position of the pension scheme is ring fenced from the company. There is no company access to this funding.

Analysis of net debt

£m	Group Balance at year end
Cash and cash equivalents	907
Current interest bearing deposits maturing after 3 months	1,533
Bank and other loans	(1,116)
Finance leases and hire purchase arrangements	(2,965)
Year to 31 March	**(1,641)**

Source: British Airways Annual Report

The impact of BA's EV calculation would be:

Enterprise value calculation for British Airways

Current share price (p)	548.75	
Number of outstanding shares (m)	1,135.765	**£m**
Market capitalisation (£m)		6,233
Net debt at book value		1,641
MI at book value		213
		8,087
Less: Minorities and joint ventures		(131)
Enterprise value (before further adjustments)		7,956
Add: Pension deficit (net of tax)		1,603
Enterprise value (adjusted)		**9,559**

As with the accounting in the balance sheet, internationally the income statement effects of pension accounting will vary. Once more, the notes to the accounts will disclose (though don't necessarily recognise) similar figures.

Where EBITA or EBITDA is the metric of choice, the most relevant pension element is the current service cost – being the increase in the projected benefit obligation (present value of scheme liabilities) due to employees working for the company during the period. This intuitively is a wage and salary cost and thus should be charged as an operating cost.

Consequently, to calculate EBITA or EBITDA, the existing accounting number for pensions in the income statement (which may well have significant international variation) should be removed and replaced with the current service cost (as an operating expense).

The impact of adjusting for pension deficits on BA's EV multiples

The calculation below highlights the impact the pension adjustment had on the EV multiple calculations for BA. The pension deficit addition to EV accounts for 20% of the adjusted EV.

EV / EBITDA calculation for British Airways	
Enterprise value (before further adjustments)	7,956
Add: pension deficit (net of tax)	1,603
Enterprise value (adjusted)	9,559
EBITDA	705
Depreciation	717
EBITDA	**1,422**
EV (before further adjustments)	**7,956**
Add: Pension deficit (net of tax)	1,603
EV (adjusted)	**9,559**

The impact of the pension adjustment	
EV / EBITDA (originally)	5.6x
EV / EBITDA (adjusted for pensions)	6.7x

Ratings agencies' pension adjustments			
Pension adjustments	STANDARD & POOR'S	Moody's Investor Service	FitchRatings
General approach	Under-funded pension schemes treated as debt items	Deficits in funded plans are viewed as debt Liabilities of unfunded plans are assessed on a case by case basis	Deficits in funded plans viewed as debt-like
Debt adjustment	Post-tax net deficit added to total debt	Funded schemes: pre-tax deficit added to debt Unfunded schemes: split into debt and equity according to company's unadjusted debt / capital ratio	Funded schemes: post-tax deficit added to debt
Income statement adjustment	All pension costs, except for service costs, are added back to EBIT and EBITDA, if reported above the operating line		All pension costs, except for service costs, are added back to EBIT and EBITDA, if reported above the operating line

Note: See page 107 of the *Accounting and Analysis for investment bankers* manual for the definition of unfunded vs. funded plans.

Exceptional / extraordinary items

Exceptional and extraordinary items are characterised by:

- Their unusual nature (unrelated to ordinary business activities); and
- The infrequency of occurrence (i.e. not expected to happen again).

The rules vary between countries as to what should be classified as exceptional or extraordinary.

Exceptional / extraordinary items can include:

- Restructuring charges
- Impairments
- Profits and losses on disposals
- Financing one-offs (e.g. debt redemption above book value, etc.)
- A share in unconsolidated affiliates' exceptional items
- Items treated as being non-core to the operations of the business.

True exceptional and extraordinary items should be stripped out.

When adjusting net income (for equity level comps) refer to the tax notes in the accounts to find the tax effect of exceptionals. If not available use the marginal tax rate (effective rate if marginal rate not known).

Group Consolidated income statement	
Historic year end	
£m	
Traffic revenue	
Passenger	6,820
Cargo	498
	7,318
Other revenue (including fuel surcharges)	1,197
Revenue	**8,515**
Total expenditure on operations	7,810
Operating profit	**705**

Exceptional items	
Historic year end	
£m	
Recognised in operating profit from continuing operations	
Employee costs – restructuring costs	48
Depreciation – impairment of tangible fixed assets	1
Depreciation – reversal of impairment of tangible fixed assets	(13)
	36

Source: British Airways Annual Report

The above BA extract discloses an EBITA (operating profit) of £705m. However, the exceptional item note states that £36m of exceptional items has been charged in arriving at the EBITA of £705m. Normally analysts will strip out the impact of the exceptional items from EBITA and related metrics.

The impact of adjusting for exceptionals on BA's EV multiples

Enterprise value calculation for British Airways	
EV (before further adjustments)	7,956
Add: Pension deficit (net of tax)	1,603
EV (adjusted)	**9,559**
EBITA	705
Depreciation	717
EBITDA	**1,422**
Exceptional items	36
EBITDA (adjusted for exceptionals)	**1,458**

The impact of multiple inconsistency	Post exceptional	Pre exceptional
EV / EBITDA (not adjusted for pensions)	5.5x	5.6x
EV / EBITDA (adjusted for pensions)	6.6x	6.7x

Source: British Airways Annual Report

Operating lease adjustments

The accounting for leases is discussed in detail in the accounting manual. In summary, the accounting impact of leases is:

	Finance lease	Operating lease
Recognition of asset	✔	✘
Recognition of debt	✔	✘
Cash flow statement impact	Operating & financing	Operating only
Income statement impact	Operating expenses depreciation & interest	Operating expenses (operating lease rental)
Impact on EBITDA	No impact	Full impact

Accounting for a lease as a finance lease will result in the recognition of a finance lease obligation. This obligation is recognised as part of the net debt calculation.

Many reporting companies avoid this increase in net debt arising from the finance lease treatment by classifying their lease arrangements, where possible, as operating leases. This takes the debt arising from the finance

lease "off balance sheet". Many credit and equity research analysts will adjust their basic net debt calculations for the present value of operating lease commitments, thus bringing the "off balance sheet" debt back "on balance sheet".

Failure to adjust for operating leases when performing comps can lead to an overstatement of equity value when using EV multiples to value companies. This is because the net debt deduction in the breakdown of enterprise value to equity value is understated.

Problems arise, however, if the lease arrangements are treated as operating leases and the analyst wishes to restate the arrangements as finance leases.

The following adjustments would need to be made for comps purposes:

- The present value of the operating lease commitments will be incorporated within the net debt calculation and therefore included in the calculation of the comparable's enterprise value. The accounting manual examines this conversion in detail. A summary of the conversion methodologies used by the credit rating agencies is outlined below
- EBITA metrics would have to be restated by adding back the interest element of the lease rental, to ensure that EBITA is degeared and capital structure neutral
- EBITDA metrics will have to be restated by adding back both the interest and depreciation elements of the lease rental. Adding back the entire rentals number creates the EBITDAR metric
- Consistency is once more the key issue here. Bringing the operating lease commitment "on balance sheet" will increase the enterprise value of the comparable company. Without any adjustment to the denominator, a financing element would be left in the denominator. The denominator would then be capital structure dependent, whilst the numerator would be capital structure independent.

The impact of adjusting for operating lease on BA's EV multiples

Enterprise value calculation for British Airways	
EV (before further adjustments)	7,956
Add: Pension deficit (net of tax)	1,603
Add: PV of operating lease rentals (say)	2,000
EV (adjusted)	**11,559**
EBITA	705
Depreciation	717
EBITDA	1,422
Exceptional items	36
EBITDA (adjusted for exceptionals)	1,458
Operating lease rentals	250
EBITDAR (adjusted for rentals)	**1,708**

The impact of adjustments	Post exceptional	Pre exceptional
EV / EBITDA (not adjusted)	5.5x	5.6x
EV / EBITDA (adjusted for pensions)	6.6x	6.7x
EV / EBITDAR (adjusted for pensions and leases)	6.8x	6.9x

- When calculating the target's implied equity value, the present value of the operating lease commitments in the target must be in the net debt calculation and deducted in the breakdown of enterprise value to equity value.

Ratings agencies' operating lease adjustments			
Lease adjustments	STANDARD & POOR'S	Moody's Investor Service	FitchRatings
Debt adjustment	NPV of future minimum, non cancellable leases (at 10% discount rate) added to debt (alternatively 5 x multiple of net P&L charge)	8 x gross P&L charge added to debt	8 x gross P&L charge added to debt
Interest adjustment	Interest component of rents (10% of NPV result, or $^1/_3$ of net P&L charge) added to EBIT, EBITDA and interest	$^1/_3$ gross P&L charge added to EBIT and interest	$^1/_3$ gross P&L charge added to interest
Depreciation adjustment	Depreciation component (remaining amount or $^2/_3$ of net P&L charge)	$^2/_3$ gross P&L charge Full rent expense added to EBITDA (becomes EBITDAR)	$^2/_3$ gross P&L charge Full rent expense added to EBITDA (becomes EBITDAR)

Currency

Multiples (e.g. EV / EBITA) are independent of currency provided that both numerator (e.g. EV in $m) and denominator (e.g. EBITA in $m) are in the same currency. Consequently, keep financials and market capitalisation in the (same) local currency – there is no need to translate to the target's currency.

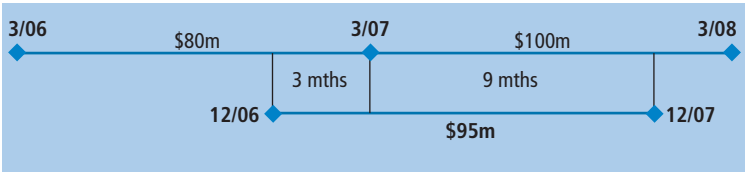
Always use the share price traded on the primary exchange (Bloomberg: RELS).

Annualisation

Financials should be adjusted for:

- Different year-ends
- Seasonality of business
- Growing / declining activity.

e.g. to annualise to December a company with a March financial year-end.

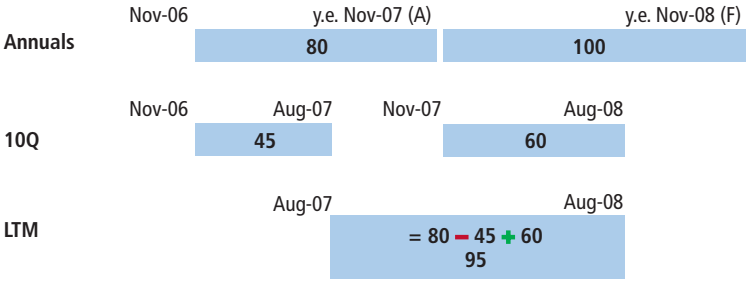


Alternatively, the annualisation can be done using quarterly or monthly accounts if these are available. For companies quoted in the US, published quarterly information is available.

LTM

Last Twelve Months (LTM) numbers are useful where the profits of the comparable businesses are growing (or declining) significantly and/or are seasonal. In these situations, annualising numbers (by pro-rating on a time basis) may be an over-simplification of the profits generated in a particular time period and may not be indicative of the companies' most recent trading performances.

Where companies have produced quarterly or half-yearly accounts, more up-to-date profit figures can be generated. For example, a US company with a year end of 30 November, may have just produced its quarterly results (10Q) for the 3rd quarter to 31 August 2007. Therefore, to find the most recent trading performance, LTM to 31 August 2007 would be calculated and compared with the LTMs (not necessarily all to 31 August) of comparable businesses. The LTM would be calculated as:



Acquisitions and disposals

When a company makes an acquisition / disposal between the latest date of its balance sheet and the day when a comps is done, a pro forma should be constructed.

The purpose of the pro forma is to compare "like with like", i.e. an adjusted enterprise value with adjusted financials for the acquisition / disposal.

The problem is there is often not enough information to make sensible pro forma adjustments for all line items. US companies tend to give pro forma revenue, EBIT and net income. European companies are likely to be less forthcoming.

Illustration – disposal

CompCo has disposed of DisposeCo since the year end		
	CompCo	DisposeCo
Market value of equity (current)	100	–
Net debt (last balance sheet)	20	5
Dispose price (in cash)	–	30
Sales	60	40
EBIT	10	4

Pro forma – disposal

	CompCo	Adjustments	Pro forma
Sales	60	(40)	20
EBIT	10	(4)	6
Equity value	100	–	100
Net debt / (cash)	20	(35)	(15)
Enterprise value	120	(35)	85
EV / Sales	2.0x		4.3x
EV / EBIT	12.0x		14.2x

Illustration – acquisition for cash

CompCo has acquired 100% of AcqCo since the year-end for 30 in cash		
	CompCo	AcqCo
Market value of equity (current)	100	–
Net debt (last balance sheet)	20	5
Sales	60	40
EBIT	10	4

Pro forma – acquisition for cash

	CompCo	Adjustment	Pro forma
Sales	60	40	100
EBIT	10	4	14
Equity value	100	–	100
Net debt / (cash)	20	35	55
Enterprise value	120	35	155
EV / Sales	2.0x		1.55x
EV / EBIT	12.0x		11.1x

Valuing the target

Having identified the comparable universe and calculated consistent multiples for a chosen level of valuation, a comps model will produce an output similar to the extract below. The comps model itself doesn't actually value the company. The model merely presents the data in a form that an analyst can then use to complete the valuation.

European airlines and airports – valuation multiple

Multiples have been calendarised to December year ends.

	P / E (x)		EV / EBITDAR (x)		EV / EBIT (adj. leases)	
	Historic	Current year	Historic	Current year	Historic	Current year
Network airlines						
Air France-KLM	11.2	8.4	4.8	4.4	11.4	9.8
Austrian Airlines	NC	46.1	5.6	4.6	59.8	26.0
British Airways (GBp)	11.6	19.2	6.7	7.5	13.5	19.9
Iberia	26.4	16.5	7.4	6.7	21.5	17.0
Lufthansa	13.7	9.9	5.5	5.1	12.4	10.9
Average	**15.7**	**20.0**	**6.0**	**5.7**	**12.4**	**13.5**
Low cost airlines						
Air Berlin	**32.7**	30.0	7.8	7.0	18.4	15.4
easyJet (GBp)	22.5	15.7	9.2	7.5	15.3	11.7
Ryanair	21.2	15.8	12.4	9.1	17.2	12.6
Average	**25.5**	**20.5**	**9.8**	**7.9**	**17.0**	**13.2**

Selecting an appropriate comparable multiple

This information can be used to value the target company. Assuming the target company is to be valued using an EV / EBITDAR multiple, the first step will be to select an appropriate EV / EBITDAR multiple.

The choice is between historic and forecast multiples. Most analysts will value the target company using a forecast multiple, to reflect the forward looking nature of valuations. Based on the above table, and assuming the target company is valued using the current EV / EBITDAR multiple – there is still a choice of 10 different potential multiples, ranging from 4.4x to 9.1x. The ultimate decision will be based on the analyst's belief on how the target company best fits into the comparable range of multiples.

Does the analyst believe that the target company will trade at a premium or a discount to the comparable universe?

This is one of the key decisions in the comps process and must be justified. Such consideration could include:

Explanation of premia / discounts to peers

If trading at a premium:	If trading at a discount:

• Look to analyse market factors that could explain the premium to peers. For instance:
  • Index tracking demand
  • Market speculation
  • Positive market sentiment
  • Superior corporate governance.
	• Look to analyse market factors that could explain the discount to peers. For instance:
	  • Limited liquidity or free float
	  • Ownership restrictions
	  • Financial risk.

• Operating factors may explain the premium:
  • Growth
  • Strong competitive position relative to peers
  • Strong management team
  • Barriers to entry
  • Economies of scale
  • Lack of substitutes.
	• Operating factors explaining a discount may include:
	  • Recent negative news flow
	  • Recent missed expectations
	  • Poor corporate governance
	  • Lower barriers to entry
	  • New technology placing the company at a competitive disadvantage.

We shall assume for the purposes of this example that the target airline company (which is a network airline rather than a low cost airline) will probably trade at a premium to the average comparable network airline EV / EBITDAR multiple. The target will be valued using an EV / EBITDAR of 6.4x.

Consistency of the target earnings metric

The target's implied EV is calculated as:

Equity valuation of target	
Target EBITDAR x comparable EV / EBITDAR = implied target EV	
Target EBITDAR (£m)	2,209
Comparable EV / EBITDAR	6.4x
Implied EV of target	**14,138**

The key issue here is to ensure that the EBIDAR used in the preparation of the comparable EV / EBITDAR multiples is consistent with the EBITDAR of the target.

Breakdown to equity value

Having calculated the enterprise value, analysts are usually then interested in determining the equity value.

The enterprise value is the value of the entire firm and all of its claims. Equity shareholders are but one claim on the entire value of the firm. Therefore to identify the element of the enterprise value which equity has a claim on, we need to adjust the enterprise value for non-equity claims.

Typical non-equity claims will be:

- **Net debt**

Net debt is usually a significant claim on the firm value of a company. Debt should be deducted at market value. When a company is in financial distress or there are significant differences between book and market value, debt instruments should be marked to market. If there is no market value, its market value can be estimated by discounting the cash flows at the current refinancing rate (like valuing a bond). An estimate of the cash flows can be obtained from the accounts. The refinancing costs can be obtained by talking to bankers who know the sector.

- **Minority interest**

Minority interest represents, from an accounting viewpoint, an outside ownership interest in a subsidiary that is consolidated with the parent for financial reporting purposes. Equity shareholders have no claim over this element of enterprise value as it is owned by parties outside the group structure.

As the enterprise value multiples include the minority interest element, minority interests must be removed in the breakdown to equity value.

Enterprise value is measured at the market value of all its components. Minorities are a constituent part of firm value and should, when representing significant value, be valued at market value.

If the subsidiary, where the minority interest arises, is quoted, the market value of the minority can be derived. Practical difficulties in arriving at the market value of minorities exist where the subsidiary is unquoted. Unquoted minorities will have to be valued on a separate basis (using either DCF or comps).

Equity shareholders have an ownership claim on joint ventures and associates. The enterprise value multiples do not include the earnings generated by joint ventures and associates. This claim needs to be added back into the equity value.

As for minority interests, a market value adjustment (usually an addition) to equity value would be preferable in order to calculate the implied equity value. However, due to practical constraints the book value of joint ventures and associates is often used as a proxy for market value. If the value is a material and significant part of the valuation, a market value should be used.

Additional considerations will need to be made if the comparable multiples have been adjusted for:

- **Preference shares**
- **Pension scheme deficits**
- **Operating leases.**

Equity valuation of target		
Target EBITDAR x comparable EV / EBITDAR = implied target EV		
Target EBITDAR (£m)	2,209	
Comparable EV / EBITDAR	6.4x	
Implied EV of target		**14,138**
Less: Net debt		(1,543)
Less: Pensions deficit (net of tax)		(780)
Less: PV of operating lease commitments		(1,570)
Less: MI		(23)
Add: JV and associates		177
Implied equity value of target		**10,399**
Number of outstanding shares		6,800
Implied equity value per share		**1.53**

Common errors made in comps modelling

- Models not kept up to date with most recent information. Update comps regularly for:
  - Daily share prices
  - Earnings announcements
  - Corporate events such as M&A deals, share issues, buybacks
- Source documentation not kept for verification purposes
  - Make notes in the comps model to back up source information and adjustments made to historic and broker information
- Financials not adjusted for exceptional items
  - Exceptional items are not just what the financial statements disclose as exceptional. Analysts should be able to make a value call on whether an exceptional item is truly exceptional or not
- Impact of different accounting GAAPs not properly considered
  - Financials will need to be adjusted to a consistency set of accounting rules
- Companies with different year ends not calendarised
- Foreign currency figures not converted to a common currency
- Corporate actions taken since the publication of the most recent set of financial statements not taken into account. Always check regulatory filings and reflect this in the comp numbers
- Broker numbers blindly used without understanding the definitions they have applied and ensuring that historics and broker information is applied to a consistent definition
- Free float figure not adjusted for any significant shareholdings
- Comparables not properly selected – the comps model will calculate average metrics and multiples for the comparable universe. Do not just rely on using an average for the target company valuation
  - Review the comparables and exclude outliers from any average calculations. Make sure you justify using a comparable multiple that is above or below the average (mean or median).

Process checklist for comps

1. Understand the industry by reading analyst reports and news stories
   - What are the industry specific statistics (sales / employee etc.)?
   - What are the most important performance ratios?
   - What are the most important market multiples?
2. Select the universe of comparable companies carefully – more is not necessarily better
3. Use the most recent published financials
   - Check the web site and the financial calendar of the individual companies to ensure that the most recent published financial information is used
4. Use only the most appropriate broker
   - Ensure that the research is recent and subsequent to any company result announcements
   - Ensure that the forecast numbers are similar to global estimates
5. Mark all source documentation to show where information has been extracted from, with both a Post-it showing the page and a highlighter showing the numbers used
6. Use footnotes
   - To disclose adjustments made to the numbers
   - To explain unusual operating and financial trends
7. Always reconcile the broker historicals to the published historicals – this will help to understand how the broker has defined key metrics, e.g. EBITA and EPS, so that the historics and the forecasts can be input using the same adjustments
8. Ensure that the numbers are comparable – potentially, the more adjustments made for special situations (true exceptionals / non-recurring items, dilution, associates etc.), the more comparable, but:
   - The more time to input the comps
   - The less likely that all the desired adjustments will be visible in the brokers' research forecasts

- The more chance of errors

9. Keep the comps analysis up to date
   - Check the web site and the financial calendar of the individual companies to ensure that the most recent published financial information is used
   - Update share prices
   - Update exchange rates
10. Check the work
    - Double check for data entry or other processing mistakes
    - Step back and look at the finished product – do the results make sense?
    - Get someone else to check the work
11. Understand the results of the analysis and be prepared to discuss them. The numbers can be meaningless without solid analysis to back up the position of the metrics.

3 • Precedent transactions

Introduction

Precedent transactions analysis is using historic M&A transactions in a similar industry to the company under consideration. This enables the analyst to arrive at a value for the company under consideration.

Precedent transaction analysis is similar to comparable company analysis, except that by looking at prior acquisitions, precedent transactions capture the premium that has been paid to gain (full or partial) control of the target company (i.e. control premium).

The resultant historical multiples are based on the market prices paid by acquirers and accepted by sellers. From a potential seller's point of view, the multiples suggest a target price range that buyers have been willing to pay. For potential buyers, the multiples display price ranges that have been acceptable to sellers.

Reliability depends on the number of precedent transactions and their degree of similarity to the company under consideration. Market cycles and volatility may also affect valuation.

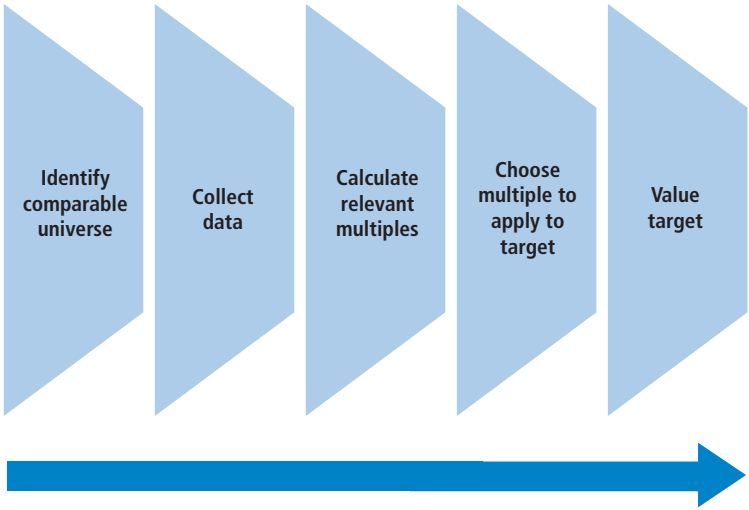
In summary, the analysis of precedent transactions allows the analyst to understand how much was paid for similar companies in the past in order to properly advise clients on the value of a company they are interested in buying, or the value of an asset they are interested in selling.

The following table highlights the major advantages and disadvantages of precedent transactions analysis:

Advantages of precedent transactions analysis	Disadvantages of precedent transactions analysis
• Based on public information • Very useful for valuing controlling stake acquisitions • Information is based on historical facts • Includes the control premium and potential synergies • Provides summary of premia paid by buyers and accepted by sellers • Useful to know the prices that have been paid for similar assets to determine the value of a comparable asset for sale.	• Public data can be limited • Difficult to know all the factors and motives that went into the formulation of acquisition prices • The fact that a particular multiple was paid in the past does not necessarily mean it still applies today • Market conditions at the time of a transaction can have a large impact on valuation.

Structured approach to precedent transactions

The structured approach to precedent transactions is similar to that used for comparable company analysis:

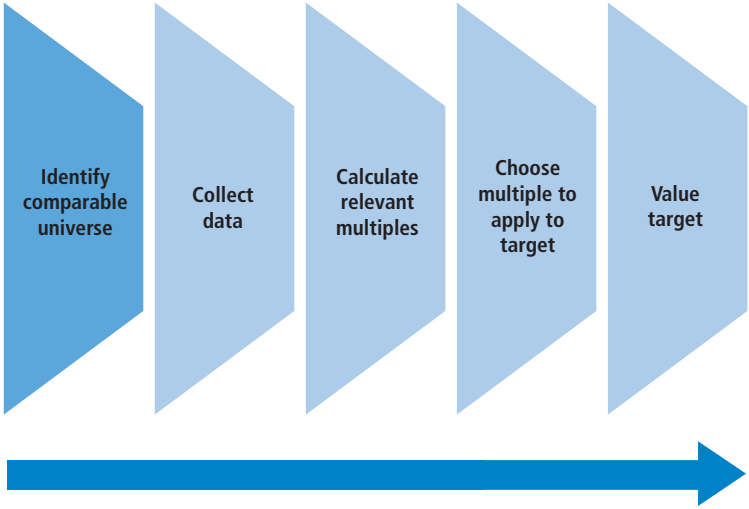


The steps are to:

- Identify the comparable universe of relevant precedent transactions
- Collect the appropriate data from the precedent transactions
  - Transaction and offer values
  - The premium paid
- Calculate the relevant multiples
- Analyse the results and choose the appropriate multiple(s) to be able to value the target.

Each of these steps are considered in turn in this chapter.

Identifying the comparable universe



Ideally, precedent transactions analysis will examine recent acquisitions in similar sectors to the target company. Comparable transactions are selected to include corporate activity of companies with similar business activities and operating in similar geographical areas.

However, since no two companies or transactions are exactly the same, the target companies (both precedent and intended target) should have similar risk and operating profiles.

The identification and analysis of such transactions may provide insight as to the:

- Relative degree of liquidity in a given industry. Where there have been numerous industry transactions and the industry is believed to be going through a consolidation phase, liquidity may be enhanced which may have an upward influence on the market price
- Perceived risks and rates of return of corporate acquirers. Depending on the parties involved, there may be sufficient information available with respect to the transactions to facilitate understanding of the valuation parameters employed by them

- Most likely buyers and post-acquisition synergies that might be expected
- Price range competitors might bid for a business.

However, although data derived from an analysis of similar precedent transactions may provide such insights, their direct application to any particular valuation is rarely meaningful as a primary valuation technique because:

- Sufficient information is not normally available to fully understand the valuation dynamics of the business acquired
- Each market transaction is unique. In the end the price and consideration paid are a function of purchaser and vendor knowledge, needs, negotiating skills, and bidding competition
- The transaction price is comprised (either implicitly or explicitly) of the perceived intrinsic value of the acquired business plus purchaser perceived post acquisition synergies. Therefore, even where sufficient information exists to compute earnings and cash flow multiples in an acquisition, in the absence of direct involvement with the purchaser, it will be difficult to meaningfully analyse the synergies value component
- Valuations change overtime.

The application of market transaction multiples is further complicated where all or part of the consideration paid involves a non-cash component such as:

- Shares of the acquirer
- 'Earn-out' arrangements.

Where this is the case, a cash equivalent price should be estimated for purposes of comparison. In many cases, insufficient detail regarding the fair market value of the non-cash components is available or determinable. Further, where market transactions are old, important changes in the industry, business, and economic factors during the interim period must be considered.

The factors to consider when identifying the comparable universe are as follows:

- Business activities – industry, products and distribution channels
- Geographical location
- Size
- Growth profiles (including seasonality and cyclicality)

- Business models
- Accounting policies
- Public vs. private.

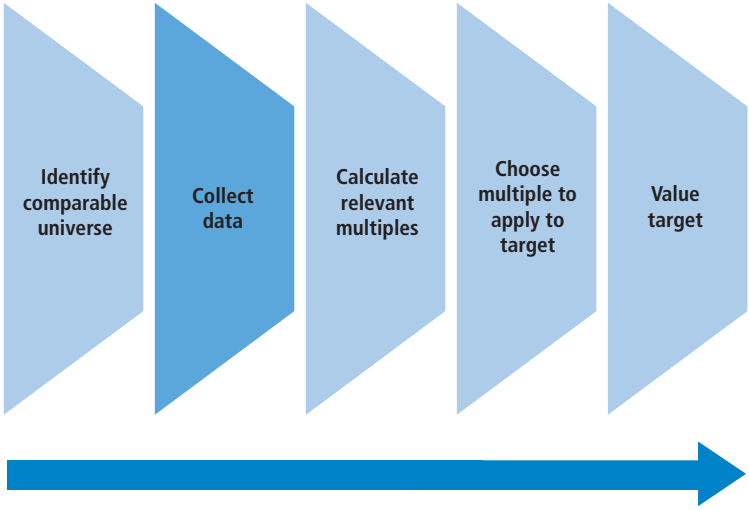
Additionally, the transactions should, ideally:

- Be for similar acquisition proportions
  - The premium for a 30% stake will be lower than for a 100% stake
- Be for similar considerations (cash vs. debt vs. equity)
  - It is likely that a 100% cash offer will be at a lower price than a 100% equity offer
- Involve similar bidder companies (trading vs. private equity)
  - Private equity acquirers do not usually incorporate synergies in their offer price
- Arise during similar equity market conditions
  - Recent transactions are a more accurate reflection of the values buyers are currently willing to pay. The public equity markets and the availability of acquisition finance can change dramatically over short periods.

Consequently, it is better to use a small number of relevant transactions rather than a large number of less relevant ones.

However, looking at a substantial number of historical transactions can be used to highlight trends in a particular industry with similar transaction profiles (recommended offer vs. hostile bid vs. contested).

Collecting data



The initial identification of the comparable universe will normally be completed with the use of an M&A database. SDC platinum is the most often used resource.

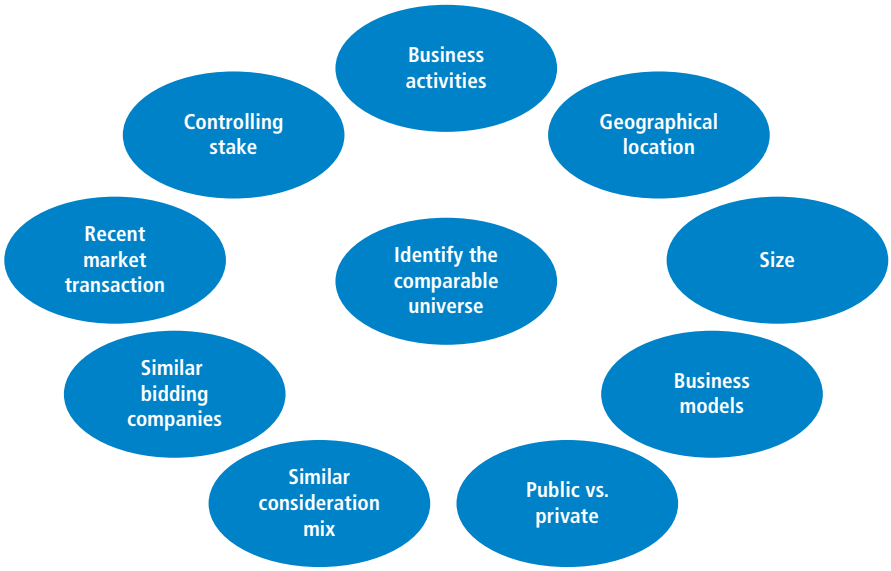
SDC Platinum is a Thomson Financial product. It is a collection of databases with information on financial transactions. The M&A and New Issues databases are the two most commonly associated with this service. The data goes back to 1979 (US) or 1985 (non-U.S.) and covers more than 273,000 transactions and offers more than 1,400 detailed information elements including:

- US targets and non-U.S. targets
- Joint ventures & strategic alliances.

Uses of the Mergers & Acquisitions database include:

- To learn who owns whom as of a given date
- To find competitors for a firm
- To analyse trends over time
- Most importantly, to get information on the premium and multiples paid per deal.

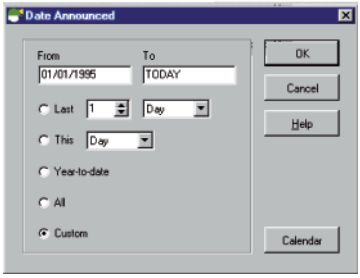
Comparable universe parameters



Using SDC to extract an initial comparable universe

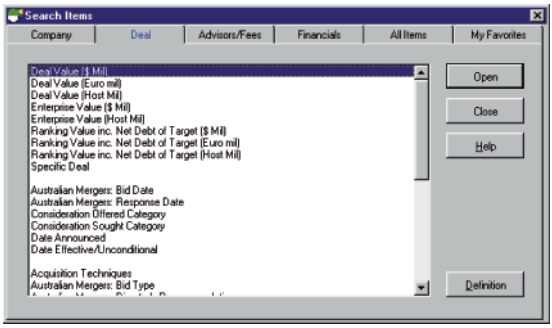
The SDC M&A database allow analysts to identify an initial comparable universe through a variety of search fields.

The first step in order to determine the initial comparable universe will be to define the period over which the transaction search will run. For the M&A database the date range reflects the date the merger / acquisition was announced. Enter a custom date range or choose from pre-set time periods, (e.g. last two quarters), then click OK.



Source: SDC platinum

The next stage in the process is to choose from the search items window the required search criteria.



Source: SDC platinum

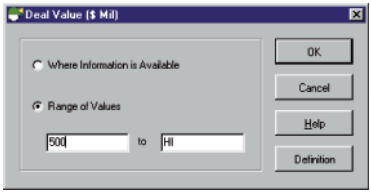
The search Items window contains lists of frequently used search items, categorised into tabs. The All Items tab lists all searchable data items.

Common SDC search fields

Data	Description
Date	Announcement and/or closing date of transaction
Bidder	Bidder name including parent name if bidder is a subsidiary
Target	Target name including parent name if target is a subsidiary
Target – business description	Very short description of target's business activity
Local currency	Currency in which the transaction took place
Acquired stake	% of the target being acquired (usually 100%)
Equity value	Equity consideration to be paid by the bidder
Grossed-up equity value	The equity value adjusted when the acquired stake is less than 100%, to reflect the equity value for 100% of the target
Net debt acquired	Typically, the net debt of the target. However, special arrangements are possible whereby the acquisition is debt-free or the bidder agrees to take on only part of the target's debt
Implied enterprise value	Grossed-up equity value plus net debt acquired

Term	Definition
Firm value	Enterprise value + minority interest
In the money share options	In-the-money share options (and all Long Term Incentive Plans, LTIPs) will be exercisable upon the acquisition and so should be converted (using the treasury method – i.e. after accounting for exercise price) when calculating the equity and enterprise values. Similarly, convertible debt may be convertible into shares. Equity and enterprise value must be adjusted commensurately.
Offer value	Offer value is similar to equity value. It is also called total equity purchase price. Offer price = Total shares outstanding* x offer price – option proceeds * Shares outstanding + in-the-money options + shares from in the money convertible debt. If there is a change of control event in the options, all in-the-money options will exercise, not just those options that are exercisable.
Rank value	Rank value = Transaction value – liabilities assumed + net debt Rank value is only calculated when all of the following conditions are met: • Target is public • The acquiror is attempting to acquire 100% of the target from a currently held percentage of less than 50% • The deal value is disclosed • The target is **NOT** a bank, securities brokerage firm, credit institution, insurance company, or leasing company. * If rank value is not calculated, it will be the same as deal value * Preferred equity is not included if cost to acquire preferred shares is included in transaction value.
Transaction value	Similar to enterprise value. Also called total consideration. The transaction value is the amount that the acquirer paid for the % of the target they are acquiring plus any liabilities assumed if publicly disclosed. Transaction value = Offer value + total debt* + preferred shares + minority interest – cash and cash equivalents * Total debt excludes convertible securities as these are assumed to convert into common shares.

The SDC search can search within deal size parameters.



Source: SDC platinum

It is worth bearing in mind an SDC search where the search criteria are not narrowly defined, will produce a very large sample of precedent transactions. Many of these transactions will probably not be comparable. Therefore try to define the search criteria with as much detail as possible.

The table below outlines the search parameters for a food retail precedent transactions search on SDC.

Request	Hits	Request description
0	–	Databases: Special merger sectors (Aus/NZ) (MA, OMA, IMA)
1	–	Date announced: 1962 to today: 01/01/62 to 13/07/07 (custom)
2	153,358	Date effective / unconditional: 2000 to today: 01/01/00 to 13/07/07 (custom)
3	8,935	Deal value ($m): 200 to HI
4	343	Target mid industry: Apparel, autoret, compret, dept, food, home, inter, otherret

The results of the search can be downloaded into an excel file. An example of an SDC download is illustrated on page 85. Even with retail deals between 1 January 2000 and 13 July 2007, with deal values greater than $200m, the database identified 343 deals relevant to these search parameters.

Issues using SDC

The main issue with the SDC database output is that it does not identify the comparable universe. It simply provides the analyst with a list of transactions from which the comparable universe can be identified, using the criteria outlined in the previous section.

There is also an issue with the SDC database output, in terms of the quality and completeness of the output. Whilst the database may identify a large

number of potential comparable transactions, the information is often incomplete.

A significant number of cells in the SDC output will contain the abbreviation "np" – not provided. Also most investment bankers would rather not rely directly on the numbers included in the SDC database output.

Precedent transactions analysis can be a difficult exercise because:

- The identification of the comparable universe is time consuming, especially if the SDC search parameters have not been rigorously thought through
- The numerical data from SDC needs verification with reference to source data. This will involve analysts going back to other documents to verify the data included in the SDC output. A list of typical source documents is found below. Sometimes this source data can be difficult to isolate, especially for private company transactions.

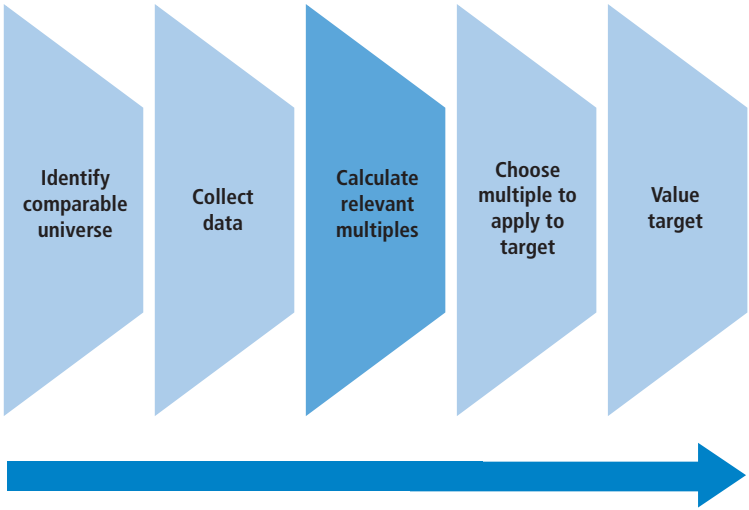
Sources of information

Information	Source
List of sector corporate activity	SDC M&A Monitor Sector brokers' reports
When target is a public company	
Offer details	Offer documents Reuters articles Regulatory News Service (RNS) for UK companies
Historic target data	Annual report and offer document – last P&L Annual report or interim results – last BS
Forecast target data	Broker research at the time
When target is a private company / division / subsidiary	
Historic target data	Parent annual report – last P&L Press articles and RNS (for UK companies) – sales & profit

Date ann.	Date effective	Target name	Acq. name	Target full business descr.	Acquiror full business descr.	Target closing price 1 day to ann. date ($)	Target closing price 1 week prior to ann. date ($)	Target closing price 4 weeks prior to ann. date ($)	Prem. 1 day prior to ann. date	Prem. 1 week prior to ann. date	Prem. 4 weeks prior to ann. date	Prem. 1 day prior to ann. Date	Prem. 1 week prior to ann. Date	Prem. 4 weeks prior to ann. Date	% of shares acq.	% owned after trans.	% sought	Value of trans. ($m)
30/08/1999	25/01/2000	Promodes	Carrefour SA	Owns and operate grocery stores; holding company	Own and operate hypermarkets	731.8481	672.41294	651.26499	20.26	33.09	38.23	20.25	33.09	38.22	95.33	95.4	100	15,837.48
29/11/1999	05/01/2000	Elkjop ASA	Dixons Group PLC	Retail electrical goods	Retail and wholesale consumer	18.6576	18.396	14.8132	7.02	9.59	37.93	7.02	9.58	37.93	100	100	100	714.854
21/12/1999	03/02/2000	Micro Warehouse Inc	Investor Group	Provide speciality catalog	Investor group	15.25	12.563	12.875	24.59	51.24	47.57	24.59	51.23	47.57	100	100	100	679.856
21/12/1999	13/03/2000	Takko Modemarkt GmbH	Investor Group	Retail men's and women's	Investor group										100	100	100	492.937
17/01/2000	01/03/2000	Lawson Inc	Mitsubishi Corp	Own and operate convenience	Manufacture and wholesale										20	20	20	1,607.69
18/01/2000	05/05/2000	Starbelly.com Inc	HA-LO Industries Inc	Retail custom-made clothing	Wholesale speciality and premium promotional										100	100	100	240
25/01/2000	10/03/2000	CompUSA Inc	Grupo Sanborns	Own and operate computer	Investment holding company	9.5	5.438	5.25	6.32	85.73	92.38	6.31	85.73	92.38	87.28	100	85.5	805.261
26/01/2000	26/01/2000	Miami Cruiseline Services	LVMH Moet-Hennessy Louis SA	Provide duty free retail sales	Manufacture luxury goods										100	100	100	300
26/01/2000	06/03/2000	Somerfield PLC Stores(46)	Investor Group	Own and operate grocery store	Investor group										100	100	100	506.327
01/02/2000	30/04/2000	Scottish & Newcastle Pubs(481)	Royal Bank of Scotland Group	Own and operate public houses	A bank and holding company										100	100	100	290.7

Source: SDC Platinum (Thomson Deals)

Calculating the relevant multiples



The precedent transactions model is used to collate the transaction information derived from various sources. The SDC platinum database output is the initial source that allows the initial identification of the comparable universe.

Once the universe has been identified, the precedent transaction model acts as a database for the collection of information that has been verified from the source documentation.

The model will then calculate comparable multiples based on the transaction information. These multiples should be inclusive of any control premium embodied in the transaction. The premium paid analysis can be calculated with reference to trailing share prices.

Precedent transactions

	Date	Currency	EV		Equity value (100%)		Premium	Consideration	Quoted?	Sales growth	
			Local (m)	€m	Local (m)	€m				Historic	Current
Bidder/ Target											
JJB Sports / TJ Hughes	31-Mar-02	£m	37	58	42	66	27.8%	cash, shares	quoted	5.2%	8.6%
Sierra Acquisitions / Oasis Stores	31-Jul-01	£m	71	112	69	109	51.7%	cash, shares	quoted	(4.0%)	n/a
Ever 1489 / Edinburgh Woolen Mill	30-Jun-01	£m	49	74	47	70	nm	cash	private	n/a	n/a
Measuremarket / Bhs	30-Apr-00	£m	200	302	200	302	nm	cash, shares	private	3.3%	n/a
Blacks Leisure Group / Outdoor Group	30-Nov-99	£m	52	79	51	77	nm	shares	private	12.2%	n/a
Alexon Group / Style Holdings	31-Aug-99	€m	39	39	37	37	75.0%	shares	quoted	17.7%	n/a
Arcadia Group / Sears (womenswear)	31-Jul-99	£m	242	369	151	230	nm	shares	quoted	5.2%	n/a
Bridgepoint / Adams	31-Jul-99	£m	87	133	87	133	nm	cash, assets	private	18.4%	n/a
GUS / Argos	28-Feb-98	£m	1,536	2,329	1,868	2,832	31.2%	cash, shares	quoted	13.9%	n/a
Etam Development / Etam	30-Nov-97	£m	107	166	93	145	nm	cash, shares	private	(5.6%)	n/a
Investors / Peacock Group	30-Apr-97	£m	78	117	78	117	nm	cash, shares	private	7.2%	n/a

			Sales growth	
			Historic	Current
Summary statistics				
Mean		46.4%	7.3%	8.6%
Median		41.5%	6.2%	8.6%
Minimum		27.8%	(5.6%)	8.6%
Maximum		75.0%	18.4%	8.6%

Precedent transactions

	EBITDA margin		EV/Sales		EV/EBITDA		EV/EBIT		EV/Sq ft (m)		EV/Freehold		Gearing	
	Historic	Current	Historic	Current	Historic	Current	Historic	Current	Historic	Current	Historic	Current	Historic	Current
Bidder/ Target														
JJB Sports / TJ Hughes	4.5%	5.0%	0.42x	0.39x	9.2x	7.7x	13.7x	11.1x	54.0x	48.6x	12.9x	12.9x	0.45x	60.0%
Sierra Acquisitions / Oasis Stores	11.2%	n/a	0.79x	nm	7.1x	nm	13.0x	nm	nm	nm	nm	nm	nm	nm
Ever 1489 / Edinburgh Woolen Mill	n/a	n/a	0.45x	nm	nm	nm	6.0x	nm	nm	nm	2.5x	nm	nm	nm
Measuremarket / Bhs	n/a	n/a	0.37x	nm	nm	nm	23.0x	nm	64.8x	nm	0.7x	nm	0.65x	nm
Blacks Leisure Group / Outdoor Group	10.6%	n/a	0.95x	nm	9.0x	nm	12.0x	nm	202.7x	nm	36.7x	nm	nm	nm
Alexon Group / Style Holdings	6.7%	n/a	0.82x	nm	12.2x	nm	17.4x	nm	nm	nm	nm	nm	nm	nm
Arcadia Group / Sears (womenswear)	4.7%	n/a	0.55x	nm	11.7x	nm	nm	nm	nm	nm	30.3x	nm	nm	nm
Bridgepoint / Adams	8.6%	n/a	0.68x	nm	7.9x	nm	17.1x	nm	nm	nm	nm	nm	nm	nm
GUS / Argos	8.4%	n/a	1.56x	nm	18.5x	nm	23.7x	nm	nm	nm	nm	nm	nm	nm
Etam Development / Etam	0.1%	n/a	0.86x	nm	nm	nm	nm	nm	161.2x	nm	3.4x	nm	0.87x	nm
Investors / Peacock Group	6.6%	n/a	1.10x	nm	16.7x	nm	29.3x	nm	156.0x	nm	11.5x	nm	0.35x	nm
			nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm	nm
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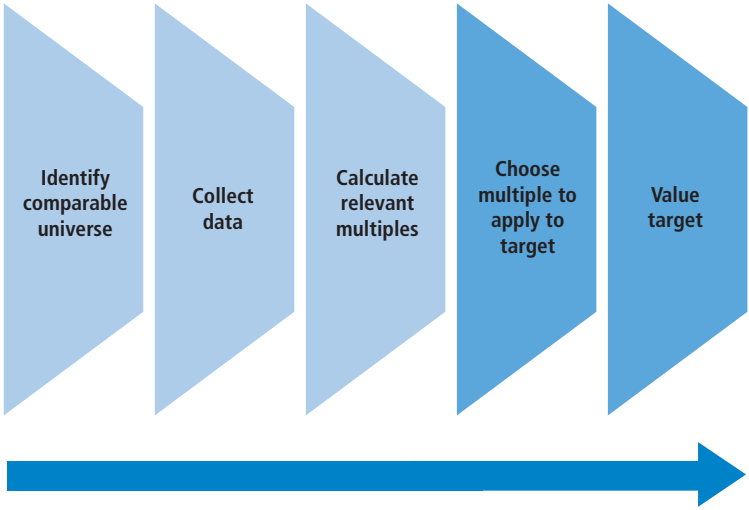
Summary statistics														
Mean	6.8%	5.0%	0.78x	0.39x	11.6x	7.7x	17.3x	11.1x	127.7x	48.6x	14.0x	12.9x	0.58x	0.60x
Median	6.7%	5.0%	0.79x	0.39x	10.5x	7.7x	17.1x	11.1x	156.0x	48.6x	11.5x	12.9x	0.55x	0.60x
Minimum	0.1%	5.0%	0.37x	0.39x	7.1x	7.7x	6.0x	11.1x	54.0x	48.6x	0.7x	12.9x	0.35x	0.60x
Maximum	11.2%	5.0%	1.56x	0.39x	18.5x	7.7x	29.3x	11.1x	202.7x	48.6x	36.7x	12.9x	0.87x	0.60x

Source: Extract Rothschild precedent transaction model

Important points to note:

- Historic and forecast data for the target company should be extracted from the most recent relevant research immediately prior to the transaction being announced – the transaction was negotiated based on these numbers and the current transaction will be based on comparable research
- Always make sure the same currency is used for both the numerator and the denominator:
  - P&L historic – use average exchange rates for the period
  - P&L forecast – use most recent exchange rate
  - B / S – use the exchange rate at the date of the BS
- All source documentation should be marked to show where information has been extracted from with both a Post-it showing the page and a highlighter showing the numbers used
- When choosing a broker, make sure the numbers are sanity checked with Global Estimates to ensure the analyst's projections are in line with peers
- Footnotes should be used for all assumptions and points of interest.

Analysing the results and valuing the target



The valuation multiples calculated from precedent transactions are applied to the relevant metric of the target company being valued in order to give a theoretical value of the target business.

There are a number of different ways to select the appropriate transaction multiple from the transaction database:

- Average / median of the transactions
- Average excluding outliers
- Range around the average
- Identify highest and lowest likely prices.

The best method will depend on:

- The quality of the information going into the precedent transactions database
- Who is the audience?
- What is the situation?

Understanding the control premium

Typically, acquisitions in the UK are made at c. 30% premium to the company's quoted value, representing a "premium for control" – in certain industries, e.g. technology; this may not be the case.

The ability to control a company has a value:

- Complete control (majority)
- Partial control (minority, significant influence, joint control).

A block of shares providing some level of control may be worth more than the sum of the values of the single shares:

i.e. 51 shares > 51 x 1 share

Consequently, transaction multiples are higher than the trading multiples of the company.

It is theoretically not correct to compare an acquisition of 5% of a company with a full take-over since, in the latter case, the Bidder would have to pay a larger premium to gain control. Consequently, purchases of small stakes, i.e. less than 25%, are likely to be excluded from the analysis. Do not compare crossing the 50% threshold (or achieving control) with a minority position.

Why pay a premium?

The ability to control a company has a value, but value in a corporate sense must be represented by future cash flows. When the equity markets value a company, they are assessing the PV of its future cash flows.

Synergies

The control premium must be justified by higher future cash flows to the new owner.

The additional cash the bidder can earn from the target arises through synergies that are not available to:

- The market; or
- The current owner (in a private transaction)

Synergies mean that the cash flows discounted by bidders are higher than the cash flows being discounted by the market (or current owner).
The synergies set a limit on how much the bidder could pay. If the acquisition

is going to add any value to the bidder, then the amount actually paid needs to be less than this maximum.

Consequently, precedent transaction multiples are impacted by the value of synergies, and the split of these synergies between target and bidder.

Premium paid analysis

The premium is calculated as: = (Offer price / Target's share price) –1

It is common to use various time frames to calculate the premium in order to remove the impact of any price sensitive leaks to the market. Common time frames are:

- 1 day prior
- 1 week prior
- 1 month prior
- One may also use averages or volume weighted averages over 10, 20, or 30 trading days prior.

The idea is to calculate the premium paid using an undisturbed share price (i.e., a price unaffected by the deal announcement or before market speculation).

Trading comparables vs. precedent comparables

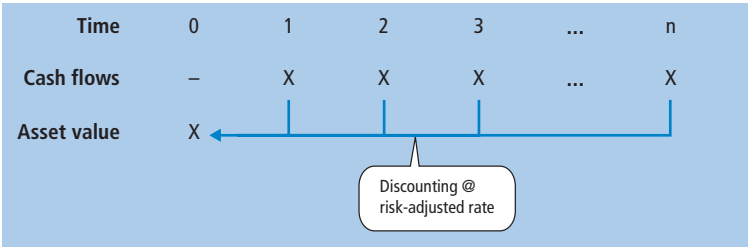
Trading comparables	Precedent transactions

• Reflect current value in public markets
• What investors are willing to pay for company at this point in time
• Often forward-looking (i.e. EV / 2009 EBITDA), although can use last twelve months (LTM) figures
• Can be influenced by other factors than cash conversion, risk and growth
  • Size and liquidity
  • Easier for large institutional investors to invest in
  • Large controlling shareholder
  • Could put smaller shareholders at disadvantage, or block value-creating takeover
  • High dividend payout
  • Reduces ability of management to re-invest earnings in value destructive activities
  • Market sentiment
  • Companies who clearly articulate their "story" to investors may trade at premium
  • Management teams with a track record of executing on plans earn the confidence of investors and may trade at a premium.
	• Reflect value at time of transaction
	• What the acquiror was willing to pay for the company at the time of the transaction
	• Often based on historical figures (LTM) figures), although can use forward estimates at the time of transaction
	• Should, in theory, contain "acquisition premium" that acquiror was willing to pay
	  • Premium reflects synergy potential of combined businesses
	  • As a result, all things being equal, precedent transaction multiples will be higher than trading comparable multiples
	  • However, this is not always the case. It is dependent on current market sentiment.

4 • Discounted Cash Flow (DCF) fundamentals

Introduction to DCF

It is a fundamental principle of asset valuation that the future cash flows expected to be generated by an asset discounted at a rate adjusted for the risk of those future cash flows will yield the intrinsic value of that asset.



This principle can be applied to the valuation of the debt and equity instruments issued by a business, and by extension to the business itself.

This methodology has the advantage that it is based on cash flows, and so is unaffected by many of the accounting issues that hamper earnings-based valuation approaches. It has the disadvantage that it is highly sensitive to the underlying assumptions used in the calculation of the cash flows and the discount rate.

Calculating a DCF valuation raises some key questions which must be answered:

- **Cash flows**
  - Which cash flows should be used?
  - How should these cash flows be correctly calculated?
  - How should the cash flows be forecasted forwards?
  - For how long should these cash flows be forecast?
- **Discount rate**
  - Which discount rate should be used?

- How should this discount rate be correctly calculated?
- How should this discount rate be appropriately applied to the future cash flows in order to calculate their present value?

To answer the first of each of these sets of questions, it needs to be understood that DCF valuation techniques, as with other methodologies, can be used to generate valuations at both the equity level and the enterprise level.

If calculating the equity value, the cash flows must be those attributable to the equity-holders, i.e. dividends or the free cash flow to equity (FCFEq). The discount rate must be the rate of return required by the equity-holders, i.e. the cost of equity (Ke).

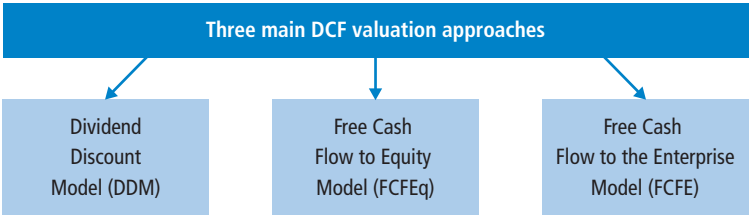
Conversely, if calculating the enterprise value, the cash flows must be those attributable to both the debt- and equity-holders, i.e. the free cash flow to the enterprise (FCFE). The discount rate must be the blended rate of return required by both the debt- and equity-holders, i.e. the weighted average cost of capital (WACC).

It is essential that the cash flows and discount rate are **NOT** mismatched.

	Equity value	Enterprise value
Cash flows	Dividends FCFEq	FCFE
Discount rate	Ke	WACC

The three main DCF approaches are:

1. Dividend Discount Model
2. Free Cash Flow to Equity Model
3. Free Cash Flow to the Enterprise Model.

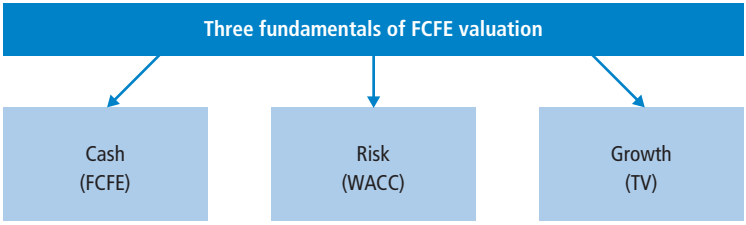


The following sections will focus on the Free Cash Flow models in turn, highlighting the remaining issues on cash flows and discount rates. Please refer to Chapter 5 in relation to the DDM model.

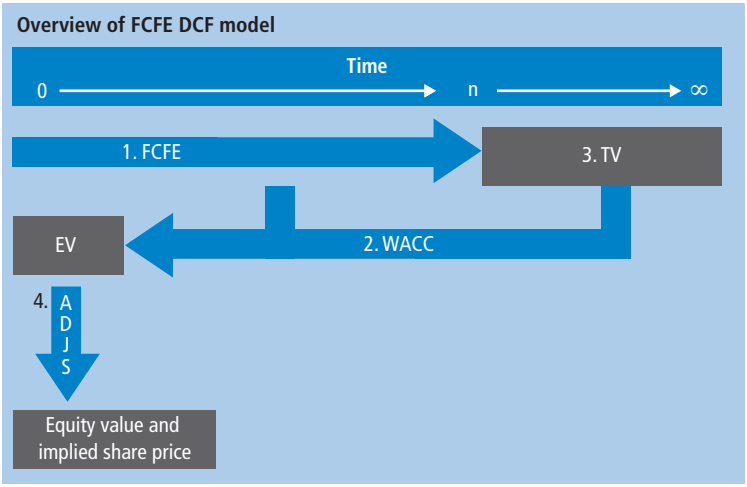
Free Cash Flow to the Enterprise model

The Free Cash Flow to the Enterprise Model is the most commonly used version of the available DCF models. As with all valuations, it is based on the following **three** fundamentals:

1. **Cash**
   - In the form of free cash flow to the enterprise (FCFE).
2. **Risk**
   - In the form of the weighted average cost of capital (WACC).
3. **Growth**
   - Principally in the form of the terminal value (TV).



Each of these three fundamental issues will be looked at in order. Finally the method to adjust from the resultant enterprise value (EV) to the equity value, and an implied share price, will be covered.



Free Cash Flow to the Enterprise

With regards to free cash flow to the enterprise, the **three** key questions that need to be answered are:

1. How should FCFE be correctly calculated?
2. How should forecasts of FCFE be correctly driven forward?
3. For how long should forecasts of FCFE be continued?

Calculation of FCFE

The FCFE model uses a very specific definition of FCFE. However, this can still be calculated in a number of ways. The most commonly used method is as follows:

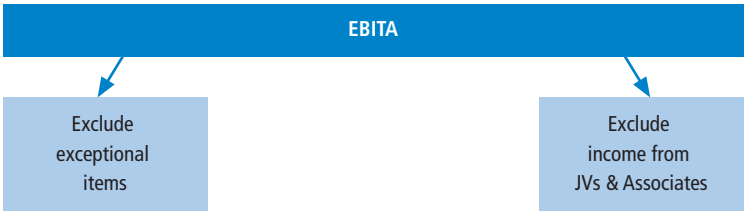
FCFE – calculation	
1. EBITA	X
2. Depreciation	X
EBITDA	X
3. Capex	(X)
4. Working capital (investment) / release	(X) / X
5. Tax paid (unlevered)	(X)
FCFE	**X**

1. EBITA

The calculation starts with EBITA (earnings before interest, tax and amortisation of goodwill). As usual, this should be before any exceptional items, in order to arrive at the underlying earnings on which forecasts can be based.

Generally any income from joint ventures and associates is also excluded. Under IFRS, this is normally reported using the equity method of accounting as a single number post-tax in the income statement. Given the lack of information in the published financial statements, it is usually very difficult, if not impossible, to convert this into its equivalent EBITA number.

For that reason, it is generally easier to deal with the value of interests in joint ventures and associates as an adjustment at time zero. This approach may need to be reconsidered if the value of interests in joint ventures and associates is a significant proportion of the total enterprise value, or if proportional consolidation is used for joint ventures under IFRS.



2. Depreciation

Depreciation of tangible and non-goodwill intangible fixed assets will have been deducted in arriving at EBITA, the starting point. Since, these are non-cash expenses and accruals-based rather than cash-based numbers, depreciation is added back to arrive at EBITDA.

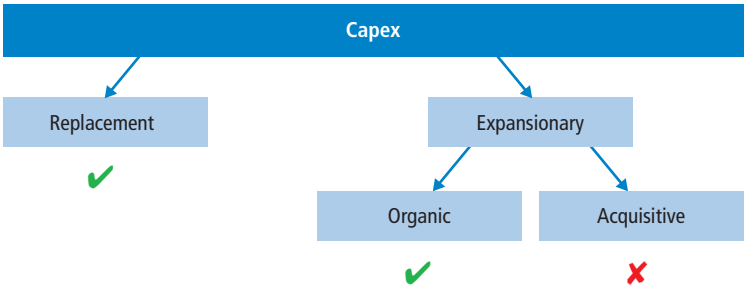
3. Capex

Having just added back the accruals-based cost of the longer-term assets, it is necessary to replace that by deducting the cash-based cost of those assets, so as not to ignore this real cost to the business and so over-value it.

This capex deduction should include both replacement / maintenance capex (for which depreciation may be used as a proxy) and expansionary capex, as the FCFE model is predicated on growth and that growth is unlikely to be achieved without the necessary long-term investment in the business. The capex figure should, therefore, generally be higher than the depreciation

figure. N.B. Bankers often use "normalised" cashflows in the terminal value calculation where capex is trended to equal depreciation.

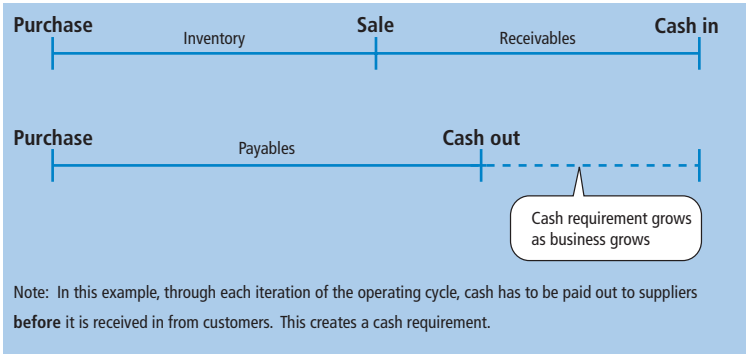
Generally, the capex figure should exclude M&A activity. It is difficult to predict such activity into the future and the model is normally based on organic growth, rather than growth through acquisition. Again, this approach may need to be reconsidered if the strategy of the business in question is primarily one of growth through acquisition.



4. Working capital investment / release

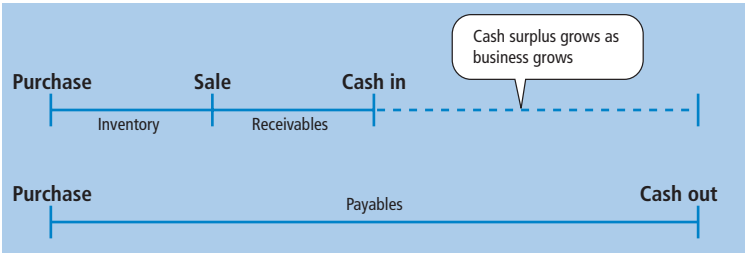
Since the model is based on growth, it is necessary to consider the need for continued investment in day-to-day working capital. As most businesses grow, more cash will become tied up in items such as inventory and accounts receivable, as compared to the cash made available through increased accounts payable.

This will lead to an increased investment in net working capital. More cash being used in this way means that less will be available, or "free", to provide returns to the debt and equity finance providers.



Note: In this example, through each iteration of the operating cycle, cash has to be paid out to suppliers **before** it is received in from customers. This creates a cash requirement.

It is worth noting that the above is not the case for all types of business. Retailers, for example, especially supermarkets, tend to release cash from their working-capital cycle as they grow, as the increase in payables tends to dwarf any increase in inventories and receivables. So, working capital becomes a source, rather than a use, of cash.



Note: Through each iteration of the operating cycle, cash is received in from customers **before** it has to be paid out of suppliers. This creates a cash surplus.

5. Tax paid (unlevered)

Since the model requires the calculation of free cash flow to the enterprise or **unlevered** free cash flow, all of the numbers, including tax paid, must also be unlevered – i.e. they must ignore the capital structure of the business and its consequences.

The calculation must not reflect the benefit of the tax-deductibility of the interest on the debt finance (the interest tax shield). This benefit will be built into the model later within the WACC (by using a post-tax cost of debt).

The easiest way to achieve this is to apply an appropriate tax rate (this will be discussed below) to the EBITA figure (using EBITA as a proxy for pre-interest taxable profits). This automatically results in an unlevered tax number, i.e. the taxes on the operations

N.B. If FCFE is being calculated using historical data or a fully-integrated financial-statements model, there is a problem. The tax paid figure will be levered (i.e. post-interest). The tax figure will be too low as it will have been calculated after deducting interest expenses. This would give too high a FCFE and would result in an over-valuation of the enterprise.

This must, therefore, be adjusted for the interest tax shield. By multiplying the interest expense by the tax rate we can calculate the interest tax shield. This amount must then be deducted in arriving at FCFE, to remove the

benefit of the tax-deductibility of the interest, reduce the FCFE and correctly lower the enterprise value of the business.

Illustration – interest tax shield

EBITA	500
Interest expense	(100)
EBT	400
Tax expense (30%)	(120)
Net income	280
Levered tax expense	120
Interest tax shield (100 x 30%)	30
Unlevered tax expense	150
Tax on EBITA (500 x 30%)	150

Both methods arrive at the same answer for tax paid

The following shows the overall FCFE calculation:

Illustration – FCFE calculation

EBITA	1,000
Depreciation	200
EBITDA	1,200
Capex	(350)
Working capital investment	(50)
Tax paid (30%)	(300)
Free cash flow to the enterprise	**500**

Tax is based on EBITA

Capex is greater than depreciation

Forecasting FCFE

There are **seven** macro-level drivers of FCFE valuations. They are:

1. Revenue growth
2. Operating margins
3. Capex investment rate
4. Working capital investment / release rate
5. Cash tax rate

6. WACC
7. Terminal growth rate.

The first five of these relate directly to the forecasting of FCFE and are dealt with here. The final two are considered later.

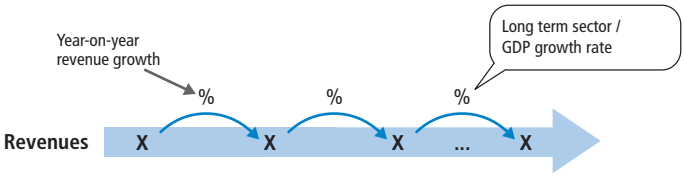
Key drivers of FCFE

A proper understanding of these first **five** drivers is essential in creating credible forecasts of FCFE:

1. Revenue growth

Revenue growth is the single most important driver in the FCFE model. For a thorough valuation, it may be necessary to perform a full bottom-up forecast of future expected revenues, broken down, for example, by product / service lines and geographical locations.

For a more "quick and dirty" valuation, top level growth percentages will suffice. While relatively high growth rates might persist for some years, they would be expected to decline over time, ultimately towards the long-term sector / GDP growth rate. It will also be necessary to take into account the target company's strategy and any cyclicality in its sector.

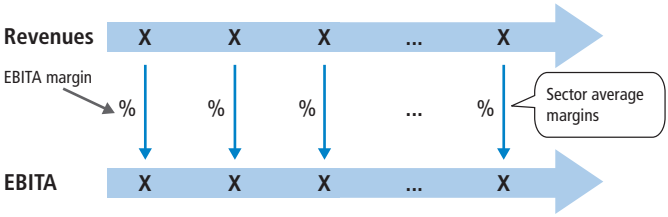


2. Operating margins

Starting the FCFE calculation with EBITA, means the focus is on EBITA margins. Again, this analysis could be broken down further into, for example, labour and materials costs as a percentage of revenues.

We use EBITA as a short rather then EBITDA as it is useful to have depreciation as a separate line item.

Generally, the expectation is that these margins will be eroded over time, to a sector average. However, if a business has a strategy of selling more higher-margin products / services in the future, its margins could actually improve.

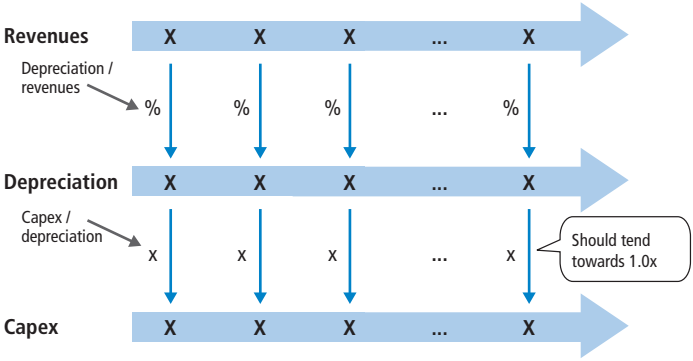


3. Capex investment rate

Capex can be forecast in a number of ways, but most of them tend to relate back to revenues. The argument being, very simply, that the more products / services a business wants to sell, the higher the investment in assets.

For example, depreciation could be forecast as a percentage of revenues and capex could then be forecast as a multiple of depreciation. This multiple would be expected to tend towards one over time, as revenue growth declines and capex becomes more about maintenance and less about expansion.

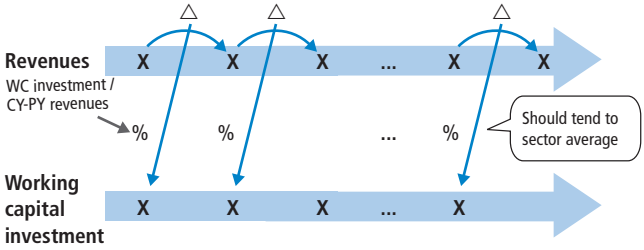
This is very much an overview short cut. A more comprehensive model would have a number of separately calculated capex and depreciation sheets.



4. Working capital investment / release rate

As revenues grow, for most businesses, more cash will become tied up in working capital. This extra investment requirement is related to the increase in revenues from one year to the next. As such, the working capital investment will often be forecast based on a percentage of the increase in revenues from the current year to the following year. Again, this might be expected to tend to a sector average over time.

In a fully-integrated financial-statements model, inventories, receivables and payables could all be forecast separately, based, for instance, on days ratios.



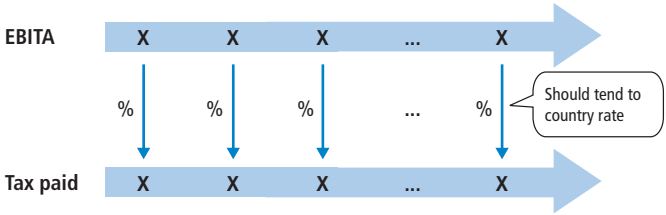
5. Cash tax rate

The main choices are an effective tax rate (calculated from the published financial data) or the country tax rate. If these two are different (for example, if the effective rate is lower than the country rate), it should be considered why this is the case and whether the difference is sustainable.

If the difference is due to creative tax planning / structuring it may be more sustainable. If it is due to tax losses brought forward, it would be expected that these losses would be used up over time. These net operating losses could be extracted and valued separately.

There is no consensus on the appropriate discount rate for net operating losses (NOLs) but most commonly they would be discounted at the pre tax cost of debt as they are unlikely to fluctuate with earnings.

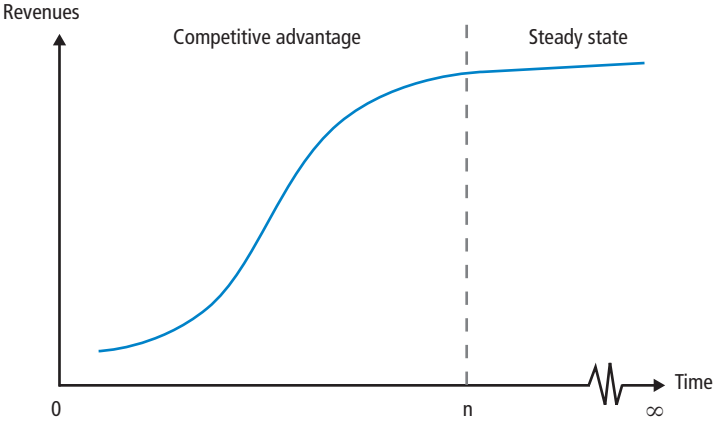
In any case, a short-term low effective tax rate would not normally be expected to persist into the long term. It is most likely that the effective rate would tend towards the country rate.

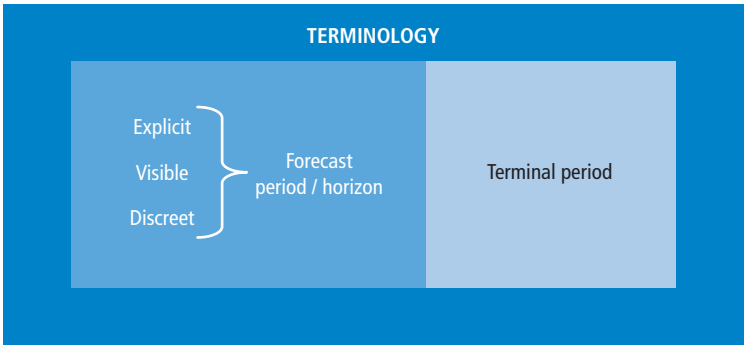


Length of the FCFE forecast period

The final question to answer with regards to the FCFE is how long to forecast. Theoretically, the FCFE should be forecast explicitly for as long

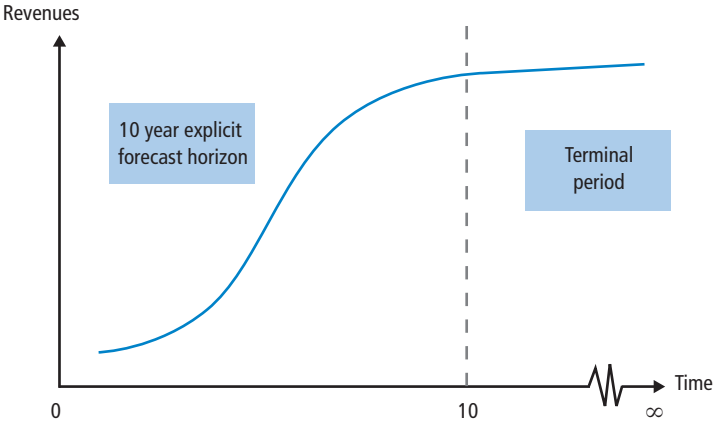
as the enterprise in question enjoys a competitive advantage and until it achieves a steady state of growth, at which point there is no longer any reason to forecast year-on-year individually.





However, the longer the explicit forecast, the less reliable those forecasts become. So, in practice, it is acceptable to default to a standard ten-year explicit forecast horizon. This length of time should be long enough to see the evolution of the firm, as well as enough time to trend the forecasts towards a more steady state of growth.

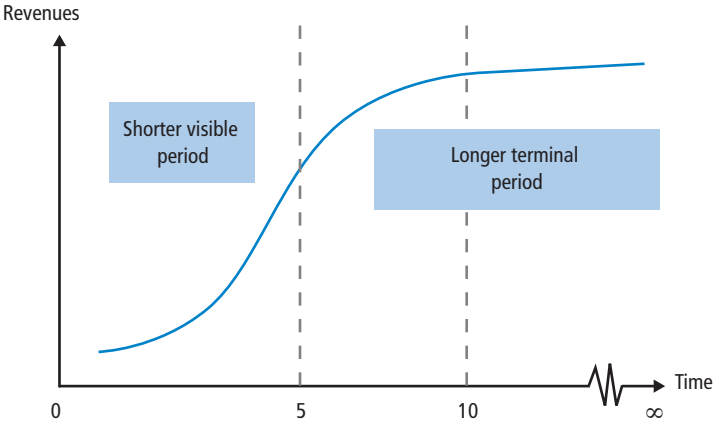
Standard approach



To save time, it is possible to shorten the ten-year period to a five-year period. However, this poses a problem. One of the weaknesses of the FCFE model is that, commonly, the lion's share of the enterprise value is derived from the terminal period, where the cash flows have not been forecast explicitly – they are invisible. This, therefore, raises the question of where the value is coming from.

Shortening the explicit forecast horizon to five years is likely to exacerbate this problem, giving an even more disproportionate split between the present value of the visible cash flows and the present value of the terminal value. It is also less likely that the firm being valued will have achieved a steady state of growth.

Alternative approach

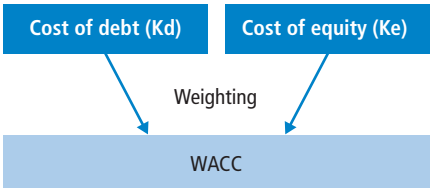


Some sectors, such as utilities and infrastructure, tend to use much longer forecast periods.

Weighted Average Cost of Capital

As stated earlier, since the calculation is an enterprise value, the FCFE must be discounted at the weighted average cost of capital (WACC). To calculate the WACC, there are **three** elements required:

1. Cost of debt (Kd)
2. Cost of equity (Ke)
3. Weighting to blend Kd and Ke into a WACC.



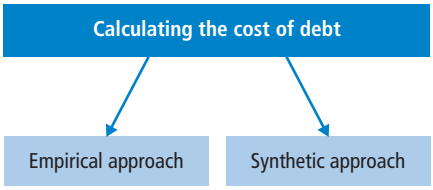
An issue dealt with later is whether to use year-end or mid-year discounting.

Cost of debt

The cost of debt is the return required by the debt finance providers of the business, i.e. the rate of interest that they will charge on the capital they lend.

There are **two** main approaches to calculating the cost of debt:

1. Empirical
2. Synthetic.



Empirical approach

The empirical approach is only really possible if the business being valued has quoted debt instruments. In these circumstances, the yield on these quoted bonds can be observed. Assuming the bond market is reasonably efficient, this yield should be a fair approximation of the cost of debt of the business.

It is important to remember that this yield is the required return of the bondholders of the business. It is, therefore, the pre-tax cost of debt of the business. Since FCFE is after tax, this yield must be converted into post-tax cost of debt.

Post-tax Kd = Yield on quoted bond x (1– t)

t = Tax rate

This is also essential as the FCFE has been calculated using unlevered tax figures and so does not reflect the benefit to the business of the tax-deductibility of the interest on its debt finance. This benefit is built into the valuation through the use of the post-tax cost of debt.

Synthetic approach

The synthetic approach involves constructing a post-tax cost of debt using the following **three** elements:

1. Risk-free rate of return
2. Credit risk premium
3. Interest tax shield.

The formula takes the following form:

Post-tax Kd = (Rf + CRP) x (1– t)

Rf = Risk-free rate of return
CRP = Credit risk premium
t = Tax rate (marginal – see later)

Risk-free rate of return

In a mature economy, such as the UK, the return on government debt is the best proxy for the risk-free rate of return. However, there will usually be numerous government bonds in issue at any point in time, so it is necessary to decide which one to use.

The cost of debt, and the WACC, is going to be applied to all of the future cash flows of the business, i.e. both those from the explicit forecast horizon and those from the terminal period. The cost of capital, therefore, has to apply from time zero to infinity.

This would suggest using the yield on perpetual / longer-dated (thirty to fifty years) gilts as the risk-free return. However, there may be no / few such gilts in issue. If this is the case, a thin market for the bonds will give an unreliable proxy for the risk-free rate of return.

Therefore, the standard approach is to use the yield on a benchmark, mid-coupon, ten-year gilt. This will normally be one of the more liquid gilts and should, therefore, give a more reliable proxy for the risk-free rate of return.

UK GILTS – cash market

		Bid	... Change in yield ...				... 52 week ...		Amount
Feb 14	Price (£)	yield	Day	Week	Month	Year	High	Low	£m
Tr 5pc '08	99.99	5.12	+0.01	+0.04	-0.06	-0.30	100.01	99.49	14,928
Tr 4pc '09	99.66	4.33	-0.01	+0.23	-0.02	-1.06	99.89	97.05	16,974
Tr 4.75pc '10	101.10	4.24	-0.01	+0.19	-0.01	-1.09	101.53	97.05	12,774
Cn 9pc Ln '11	114.65	4.33	-0.02	+0.19	+0.01	-0.94	115.39	111.14	5,664
Tr 5pc '12	102.58	4.30	-0.01	+0.20	+0.05	-0.90	103.34	96.93	14,009
Tr 8pc '13	117.23	4.49	+0.01	+0.18	+0.12	-0.63	118.43	111.64	6,489
Tr 5pc '14	102.79	4.50	+0.01	+0.19	+0.14	-0.57	103.96	95.99	13,699
Tr 4.75pc '15	101.14	4.57	+0.02	+0.20	+0.19	-0.44	102.74	94.37	13,647
Tr 4pc '16	95.80	4.60	+0.01	+0.20	+0.20	-0.35	97.53	89.02	13,500
Tr 4.75pc '20	100.78	4.66	+0.02	+0.20	+0.22	-0.16	103.26	93.94	10,743
Tr 8pc '21	132.01	4.73	+0.02	+0.20	+0.22	-0.11	135.33	124.86	17,573
Tr 5pc '25	103.91	4.67	+0.03	+0.20	+0.25	-0.02	107.52	97.34	16,188
Tr 6pc '28	117.39	4.68	+0.03	+0.20	+0.25	+0.09	121.92	111.19	12,340
Tr 4.25pc '32	94.92	4.60	+0.03	+0.20	+0.25	+0.14	99.33	89.59	17,326
Tr 4.25pc '36	95.33	4.55	+0.03	+0.19	+0.24	+0.16	100.52	90.20	15,668
Tr 4.75pc '38	103.64	4.53	+0.03	+0.18	+0.23	+0.18	109.78	98.49	14,958
Tr 4.25pc '55	96.91	4.41	+0.03	+0.16	+0.18	+0.28	105.49	93.37	11,602
War Ln 3.5pc	76.09	4.60	+0.03	+0.18	+0.24	+0.16	81.89	71.23	1,939

Source: www.ft.com 15/02/08

Note: These are the two closest gilts listed to the benchmark ten-year period

Benchmark government bonds

Feb 14	Red date	Coupon	Bid price	Bid yield	Day chg yield	Wk chg yield	Month chg yld	Year chg yld
Australia	09/09	7.50	100.8550	6.91	+0.08	+0.23	+0.35	+0.77
	02/17	6.00	97.7630	6.33	+0.07	+0.15	+0.31	+0.54
Austria	01/10	5.50	103.9410	3.33	+0.07	+0.08	-0.27	-0.65
	03/19	4.35	101.0300	4.23	+0.04	+0.12	+0.09	+0.10
Belgium	03/10	3.00	99.3200	3.34	+0.06	+0.06	-0.48	-0.65
	03/18	4.00	97.8300	4.27	+0.04	+0.13	+0.12	+0.11
Canada	12/09	4.25	102.0540	3.05	-0.03	-0.03	-0.21	-1.05
	06/17	4.00	100.7800	3.90	+0.04	+0.05	+0.12	-0.24
Denmark	11/09	6.00	103.9750	3.58	+0.07	+0.10	-0.21	-0.49
	11/17	4.00	99.0350	4.12	+0.06	+0.12	+0.04	+0.03
Finland	04/09	5.00	101.6900	3.50	+0.07	+0.10	-0.30	-0.44
	09/17	3.88	98.1360	4.11	+0.04	+0.16	+0.07	-0.02
France	01/10	3.00	99.4400	3.31	+0.06	+0.07	-0.32	-0.68
	01/13	3.75	100.5800	3.62	+0.09	+0.15	-0.07	-0.43
	10/17	4.25	100.8800	4.14	+0.05	+0.11	+0.08	–
	04/35	4.75	101.7800	4.63	+0.02	+0.10	+0.13	+0.37
Germany	12/09	4.00	101.3800	3.20	+0.05	+0.08	-0.29	-0.76
	10/12	4.25	103.0700	3.52	+0.07	+0.20	-0.10	-0.50
	01/18	4.00	99.8500	4.02	+0.04	+0.12	+0.07	-0.08
	01/37	4.00	91.6100	4.53	+0.02	+0.09	+0.10	+0.31
Greece	03/11	3.80	100.3600	3.67	+0.07	+0.15	-0.05	-0.39
	07/17	4.30	99.2690	4.39	+0.05	+0.09	+0.08	+0.04
Ireland	04/09	3.25	99.6370	3.57	+0.06	+0.13	-0.22	-0.52
	10/18	4.50	102.1610	4.24	+0.05	+0.13	+0.08	-0.09
Italy	06/09	3.75	100.3500	3.50	+0.04	+0.10	-0.24	-0.51
	10/12	4.25	102.0000	3.81	+0.06	+0.17	-0.07	-0.31
	02/18	4.50	101.1280	4.41	+0.05	+0.14	+0.09	+0.09
	02/37	4.00	86.0100	4.97	+0.01	+0.08	+0.13	+0.41
Japan	03/10	1.80	102.4920	0.59	+0.01	–	-0.01	-0.19
	03/13	0.80	99.2730	0.95	+0.03	+0.03	+0.06	-0.31
	12/17	1.50	100.3000	1.47	+0.04	+0.04	+0.03	-0.27
	12/27	2.10	99.9300	2.11	+0.03	+0.04	+0.07	-0.07
Netherlands	01/10	3.00	99.4400	3.31	+0.06	+0.10	-0.26	-0.66
	07/17	4.50	103.0220	4.10	+0.04	+0.09	+0.06	-0.02
New Zealand	07/09	7.00	99.5200	7.36	+0.04	+0.06	+0.05	+0.74
	12/17	6.00	96.8200	6.44	+0.03	+0.04	+0.13	+0.40
Norway	05/13	6.50	109.7400	4.37	+0.05	+0.15	-0.16	-0.25
	05/17	4.25	98.5000	4.45	+0.04	+0.12	-0.17	-0.12
Portugal	07/09	3.95	100.5660	3.52	+0.06	+0.12	-0.21	-0.50
	10/17	4.35	100.3780	4.30	+0.06	+0.14	+0.08	+0.06
Spain	07/09	5.15	102.3630	3.43	+0.09	+0.08	-0.28	-0.43
	01/17	3.80	97.4800	4.14	+0.03	+0.12	+0.04	-0.02
Sweden	12/09	4.00	100.3360	3.79	+0.06	+0.33	+0.02	+0.02
	08/17	3.75	97.1550	4.12	+0.10	+0.21	+0.06	+0.15
Switzerland	11/09	1.75	99.4700	2.07	+0.03	+0.12	+0.11	-0.44
	01/18	3.00	101.0900	2.87	+0.03	+0.10	+0.01	+0.25
UK	03/09	4.00	99.6450	4.35	-0.01	+0.24	–	-1.17
	06/12	5.25	103.4400	4.36	-0.01	+0.19	+0.06	-0.91
	08/17	8.75	130.8500	4.70	+0.02	+0.22	+0.25	-0.26
	03/36	4.25	95.2000	4.56	+0.03	+0.19	+0.24	+0.17
US	01/10	2.13	100.4297	1.90	-0.01	-0.10	-0.54	-2.97
	01/13	2.88	100.4609	2.77	+0.07	-0.01	-0.13	-1.95
	02/18	3.50	97.3125	3.83	+0.12	+0.10	+0.19	-0.90
	02/38	4.38	95.4688	4.66	+0.14	+0.16	+0.40	-0.17

Source: www.ft.com 15/02/08

Note: This is the benchmark ten-year gilt

World markets

Interest rates	Price	Yield	Chg
US Gov 10 yr	97.31	3.83	+0.12
UK Gov 10 yr	130.85	4.70	+0.02
Ger Gov 10 yr	99.85	4.02	+0.04
Jap Gov 10 yr	100.30	1.47	+0.04
US Gov 30 yr	95.47	4.66	+0.14
Ger Gov 2 yr	101.38	3.20	+0.05

Source: www.ft.com 15/02/08

Note: The yield on this benchmark ten-year gilt is shown on the front page of the Financial Times

Note: See bonds section in *Financial markets and products for investment bankers* page 28 onwards

Credit risk premium

The credit risk premium represents the additional return, over and above the risk-free rate of return, required by the debt-holders of the business. This is due to the fact that the business is more likely to default on its debt than the government, and so the debt-holders expect this extra reward.

If the business being valued has a credit rating, then the credit risk premium will be based on this rating. The worse the credit rating, the riskier the borrower and the higher will be the credit risk premium.

Business risk / financial risk					
	Financial risk profile				
Business risk profile	Minimal	Modest	Intermediate	Aggressive	Highly leveraged
Excellent	AAA	AA	A	BBB	BB
Strong	AA	A	A-	BBB-	BB-
Satisfactory	A	BBB+	BBB	BB+	B+
Weak	BBB	BBB-	BB+	BB-	B
Vulnerable	BB	B+	B+	B	B-

Source: S&P's Corporate Ratings Criteria, 2006

Global investment grade

Feb 14	Red date	Coupon	Ratings S&P	Ratings Moody's	Ratings Fitch	Bid price	Bid yield	Day's chge yield	Mth's chge yield	Spread vs. Govts
£										
HBOS	04/08	6.38	AA	Aa1	AA+	99.89	6.90	-0.13	+1.08	+2.68
Network Rail	03/09	4.88	AAA	Aaa	AAA	100.14	4.68	-0.01	+0.03	+0.31
Boots	05/09	5.50	–	B2	BBB	94.17	10.33	-0.02	+1.62	+6.00
France Telecom	03/11	7.50	A-	A3	–	104.65	5.82	-0.01	+0.16	+1.57
Vodafone	11/32	5.90	A-	–	–	90.11	6.62	+0.17	+0.56	+2.09

Source: www.ft.com 15/02/08

Note: The table clearly shows the lower the credit rating, the higher the credit risk premium over and above the risk-free rate

If the business being valued does not have a credit rating then it is necessary to create a synthetic rating. This will involve performing a credit analysis on the financials of the business. The worse the credit metrics, the higher the synthetic rating and the higher will be the credit risk premium.

Key industrial financial ratios, long-term debt

Three-year (2002 to 2004) medians

	AAA	AA	A	BBB	BB	B	CCC
EBIT interest coverage (x)	23.8	19.5	8.0	4.7	2.5	1.2	0.4
EBITDA interest coverage (x)	25.5	24.6	10.2	6.5	3.5	1.9	0.9
FFO / total debt (%)	203.3	79.9	48.0	35.9	22.4	11.5	5.0
Free operating cash flow / total debt (%)	127.6	44.5	25.0	17.3	8.3	2.8	(2.1)
Total debt / EBITDA (x)	0.4	0.9	1.6	2.2	3.5	5.3	7.9
Return on capital (%)	27.6	27.0	17.5	13.4	11.3	8.7	3.2
Total debt / total debt + equity (%)	12.4	28.3	37.5	42.5	53.7	75.9	113.5

Source: S&P's Corporate Ratings Criteria, 2006

Key ratios	
Higher-growth period	
1. EBIT interest coverage	Earnings from continuing operations* before interest and taxes / gross interest incurred before subtracting capitalized interest and interest income
2. EBITDA interest coverage	Adjusted earnings from continuing operations** before interest, taxes, depreciation, and amortization / gross interest incurred before subtracting capitalized interest and interest income
3. Funds from operations (FFO) / total debt	Net income from continuing operations, depreciation and amortization, deferred income taxes, and other non-cash items / long-term debt§ + current maturities + commercial paper, and other short-term borrowings
4. Free operating cash flow / total debt	FFO – capital expenditures – (+) increase (decrease) in working capital (excluding changes in cash, marketable securities, and short-term debt) / long-term debt§ + current maturities, commercial paper, and other short-term borrowings
5. Total debt / Total debt + equity	Long-term debt§ + current maturities, commercial paper, and other short-term borrowings / long-term debt§ + current maturities, commercial paper, and other short-term borrowings + shareholders' equity (including preferred stock) + minority interest
6. Return on capital	EBIT / average of beginning of year and end of year capital, including short-term debt, current maturities, long-term debt§, non-current deferred taxes, minority interest, and equity (common and preferred stock)
7. Total debt / EBITDA	Long-term debt§ + current maturities, commercial paper, and other short-term borrowings / adjusted earnings from continuing operations before interest, taxes, and D&A

* Including interest income and equity earnings; excluding nonrecurring items
** Excludes interest income, equity earnings, and non-recurring items; also excludes rental expense that exceeds the interest component of capitalised operating leases
§ Including amounts for operating lease debt equivalent, and debt associated with accounts receivable sales / securitisation programs.

Source: S&P's Corporate Ratings Criteria, 2006

Much of this data can often be sourced from colleagues in the Debt Advisory team and the results of such analysis should be sanity-checked with them.

Interest tax shield

The pre-tax cost of debt of the business is calculated by adding the credit risk premium onto the risk-free rate of return. This must be converted from pre-tax into a post-tax cost of debt.

The premium can be calculated over either the ten year government bond or the swap rate (obviously the premium will be different depending on the rate used).

Pre-tax Kd = Rf + CRP

∴ Post-tax Kd = Pre-tax Kd x (1 – t)

This raises the question of the tax rate to use for this conversion. As discussed earlier, the cost of capital has to apply to the entire forecast period, from time zero to infinity.

When discussing how to drive the FCFE forecasts forwards, it was stated that the tax rate was likely to tend towards the country rate over time. This is, therefore, the tax rate that is likely to persist over the majority of the forecast period and so is probably the most appropriate for the post-tax cost of debt calculation.

This is an important point, as in many FCFE valuations a short-term effective tax rate, which is unlikely to persist over the longer-term, is mistakenly used.

Illustration – Kd for Tesco

Kd = (Rf + CRP) x (1– t)

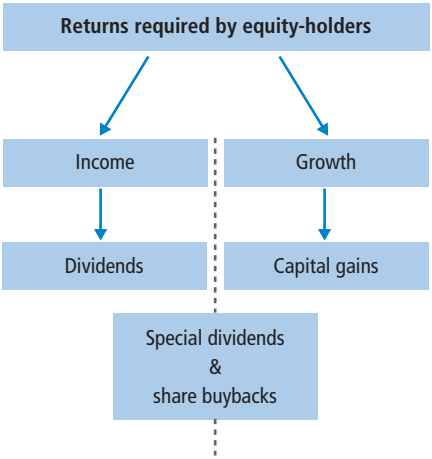
= (5.11% + 1.08%) x (1– 30%)

= 4.33%

Source: ABN AMRO, European Beta Book, 30 June 2006

Cost of equity

The cost of equity (Ke) represents the return required by the providers of equity finance to the business. This should reflect all of the returns the equity-holders expect from the business, both in the form of income (i.e. regular dividends) and growth (i.e. capital gains), as well as any returns from special dividends and share buybacks.



The Capital Asset Pricing Model (CAPM) is the method that the vast majority of valuations use to calculate the cost of equity.

It is, therefore, worth remembering that the CAPM's origins lie in Modern Portfolio Theory and the world of asset management, rather than in the fields of Investment Banking and equity research. As such, the model is built on the assumption that investors are well diversified, e.g. institutional investors, which may or may not be the case in the context of the valuations.

There are alternative models, namely Arbitrage Pricing Theory (APT) and Multi-Factor Models (MFM), but these are used much less commonly. Here, the focus is on the CAPM, which is used in the Rothschild standard DCF models.

The Capital Asset Pricing Model

The CAPM has **three** elements:

1. Risk-free rate of return
2. Equity market risk premium
3. Beta factor.

The formula for the CAPM takes the following form:

Ke = Rf + EMRP x β

Ke = Cost of equity
Rf = Risk free rate of return
EMRP = Equity market risk premium
β = Beta factor

Applying this to a real example:

Illustration – Ke for Tesco

Ke = Rf + EMRP + β
= 5.11% + 4.00% x 0.69
= 7.87%

Source: ABN AMRO, European Beta Book, 30 June 2006

Risk-free rate of return

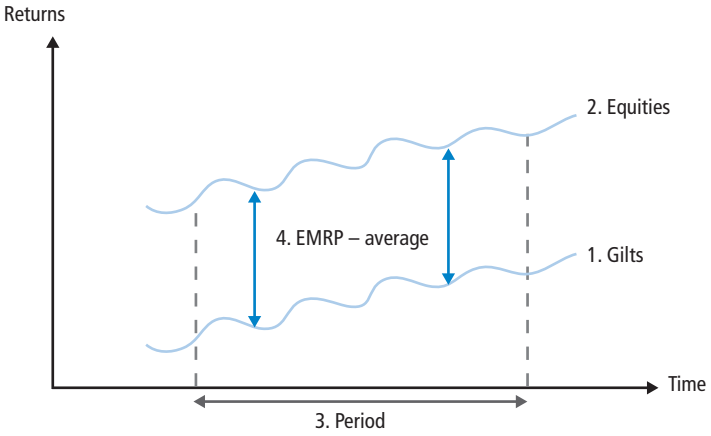
The risk-free rate of return is one of the elements of the synthetic post-tax cost of debt. Therefore, for the sake of consistency, the same figure should be used when calculating the cost of equity. (See the discussion above with regards to the choice of an appropriate risk-free rate of return).

Equity Market Risk Premium

The CAPM assumes that we are dealing with rational, risk-averse investors. Therefore, the higher the risk the investors take on, the higher the return they will require.

The risk-free rate only gives investors a return commensurate with lending money to the government. However, the investors are investing in the equity of a business. This is a significantly more risky proposition and so the equity-holders require a higher rate of return. The equity market risk premium (EMRP) reflects the incremental return, over and above the risk-free rate of return, which the equity-holders will require from their investment.

The EMRP is usually based on historical data. This raises a number of questions:



1. Risk-free rate of return

How should the risk-free rate of return be measured over a relatively long period of time? If at any particular point in time, as suggested above, the return on a benchmark, ten-year, mid-coupon gilt is used, the relevant product will change over time. This will complicate the measurement of the return.

2. Equity market return

Which equity market's returns should be measured? If, for example, a business such as Tesco is being valued, is it more appropriate to use the FTSE 100 or the FTSE All-Share? A common alternative is to use to a global benchmark such as the Morgan Stanley composite index. However, the two choices will lead to different answers for the EMRP.

3. Period measured

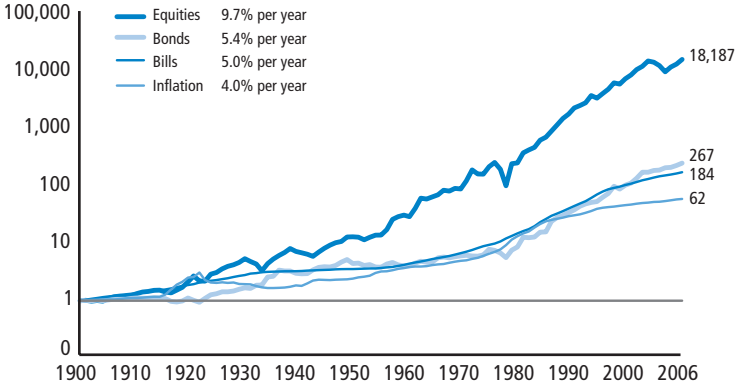
Over what period should the EMRP be measured? Different service providers, such as Ibbotson Associates and the London Business School Risk Measurement Service, measure the EMRP over various periods. Again, there is no single best answer to this question but, as with any economic metric, different periods can lead to very different answers.

4. Calculation of the average

As well as considering when and how often the EMRP should be measured during the period, how should the average over that period be calculated? An arithmetic or a geometric mean could be used. Academics continue to

argue over the relative merits of these two options. As always, they give different answers. Rothschild's view is that geometric average must be used.

Cumulative returns on UK asset classes in nominal terms, 1900-2005
Index value (start-1900 = 1.0; log scale)



Source: ABN AMRO, Global Investment Returns Yearbook, 2006

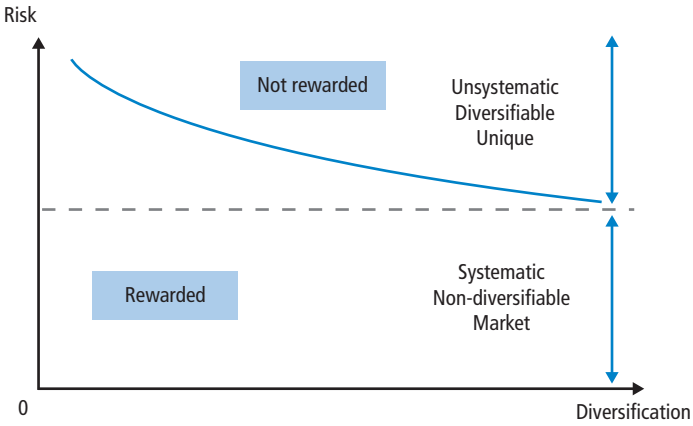
The available data seems to suggest an average EMRP in the range of 4% to 6%. It is not uncommon to use the mid-point of this range (i.e. 5%) in DCF valuations. This still begs the question of whether this past premium will continue into the future.

Beta factor

The beta factor represents the fact that some businesses are more exposed than others to the risks inherent in the market. The beta factor acts as an adjustment to the EMRP, to reflect this difference in risk and so to give a different level of return.

For example, if a business is twice as exposed as average to the inherent market risks, it will have a beta factor of two and investors will have a required return which incorporates twice the normal EMRP.

It is important, here, to remember that the CAPM stems from Modern Portfolio Theory. As it assumes that equity investors are well diversified, the CAPM only rewards them for the systematic, or non-diversifiable, risk in their investments.



This residual, systematic risk reflects the fact that, no matter how well diversified the investor, there is still uncertainty in investing in equity markets. The value of these markets can still rise or fall due to macro-economic factors, such as changes in interest rates.

The beta factor measures how much a particular investment is affected by these macro-economic factors. Some investments are more affected than others. For example, the value of a highly leveraged business will be more affected by changes in interest rates than a business with little or no debt.

Calculating the beta factor

The beta factor is usually calculated using **historical** data. This involves measuring the return on the equity investment in question versus the return of the equity market to which it belongs. As always, this raises a number of questions:

1. Equity market

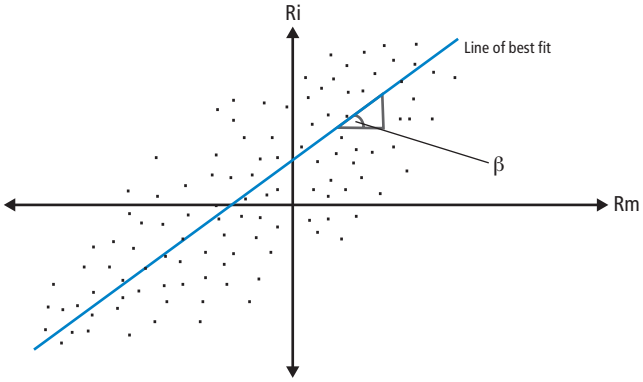
Which equity market should we use? As with the EMRP, if a business such as Tesco is being valued, is it more appropriate to use the FTSE 100 or the FTSE All-Share? There is not necessarily a correct answer to this question. However, the two choices will lead to different answers for the beta factor.

2. Period measured and frequency of measurements

Over what period and how often should the returns on the investment and the returns on the market be measured? For example, a two-year, weekly approach was used, it would be based on just over one hundred observations.

Alternatively, a five-year, monthly approach would give sixty observations, and could provide a very different result.

Once obtained, these observations are then plotted on a graph and a linear regression performed to obtain a line of best fit:



Rm = Return on market
Ri = Return on investment
β = Beta factor

The gradient of this line of best fit is the beta factor. This can also be expressed as follows:

$$\beta = \frac{\sigma im}{\sigma m^2}$$

σim = Covariance of the investment returns with respect to the market returns
σm^2 = Variance of the market returns

It is worth noting that the co-efficient of determination (R-squared) of this relationship, which measures to what extent the beta factor is really due to the market risk of the investment, can be quite low, suggesting a relatively weak relationship.

The result of the regression can be interpreted as follows:

β > 1: The investment is more exposed to systematic risk than the market in general

β = 1: The market itself has a beta factor of 1, so the investment has the same systematic risk as the market

β < 1: The investment is less exposed to systematic risk than the market in general

This Bloomberg download shows the calculation process and the results of the regression process:

HISTORICAL BETA

BAY LN Equity

BRITISH AIRWAYS PLC

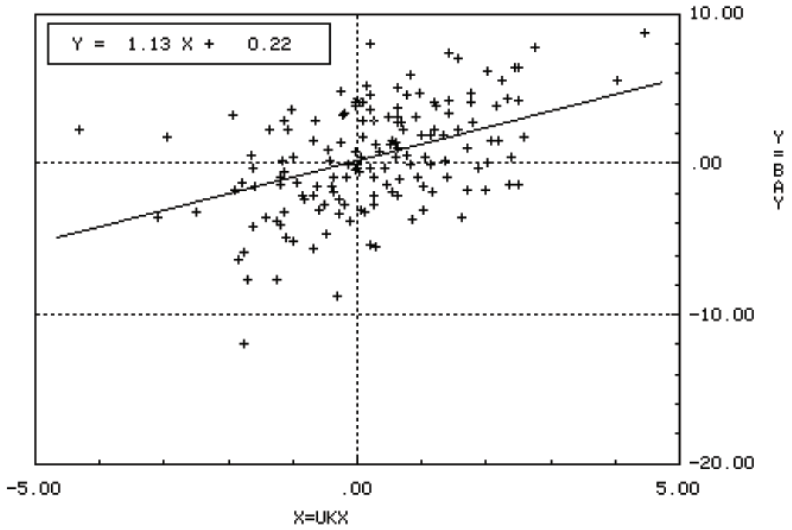
Relative Index UKX

FTSE 100 INDEX

*Identifies latest observation

Period W Weekly
Range 1/16/04 To 1/ 5/07
Market T Trade

ADJ BETA	1.09
RAW BETA	1.13
Alpha(Intercept)	0.22
R2 (Correlation)	0.18
Std Dev of Error	3.32
Std Error of Beta	0.20
Number of Points	155



ADJ BETA = (0.67) * RAW BETA
+ (0.33) * 1.0

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2007 Bloomberg L.P.
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The Bloomberg page offers **two** possible answers:

1. Raw beta
2. Adjusted beta.

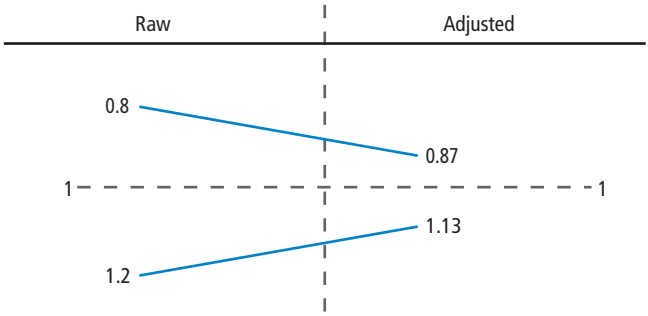
The relationship between the two is this:

$$\beta_A = \beta_R \times \frac{2}{3} + 1 \times \frac{1}{3}$$

β_A = Adjusted beta
β_R = Raw beta

The adjustment (often referred to as the Blume adjustment) gives a weighting of two-thirds to the observed beta and one-third to the market beta of one. The effect of this adjustment is to push all raw betas towards unity. There is much academic debate on this subject, analysis can be found in the LBS RMS quarterly report or on the Ibbotson website.

Illustration – adjusted betas



The argument for this is that as the business grows it will become more diversified and will more closely resemble the market in general. Therefore, its beta factor is expected to tend towards the market beta factor of one. In general, it is recommended to use adjusted betas. Although different sectors at Rothschild have different views:

- Telecoms / Utilities: unadjusted
- M&A team: adjusted

The following extract shows some of the problems inherent in calculating beta factors:

"Ideally risk measures are forward looking. In the case of beta, investors must rely on historical data over, say, the last five years. That is the problem; until recently, this period included the internet bubble, when the volatile and overvalued telecommunications, media and technology sectors comprised up to half of the S&P 500. Since the market as a whole must have a beta of one, the betas of other sectors slumped. McKinsey reckons that US food stocks' observed beta reached zero, ridiculously implying that they had the same risk as Treasuries."

Source: www.ft.com 04/09/06 Lex article "Equity beta "

The following is another Bloomberg download of a beta factor for British Airways. This time, five-year, monthly observations have been taken, rather than three-year, weekly. The beta factor thus derived is quite different from the previous download.

Use global index to calculate your beta from Bloomberg
N.B. this is a pitfall as bloomberg default setting is local.

Do not use Barra betas (methodology is not transparent).

<HELP> for explanation. P218 Equity **BETA**

HISTORICAL BETA

Number of points may be insufficient for an accurate beta.

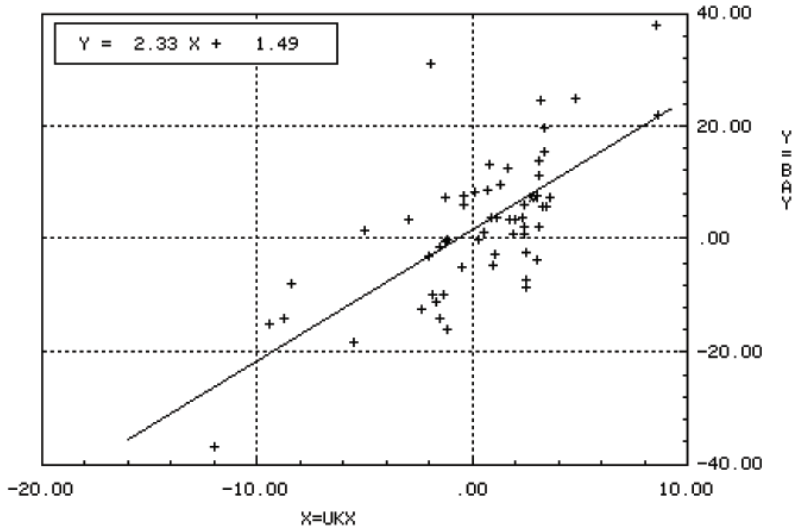
BAY LN Equity — BRITISH AIRWAYS PLC

Relative Index UKX — FTSE 100 INDEX

Period M Monthly
Range 1/31/02 To 12/29/06
Market T Trade

*Identifies latest observation

ADJ BETA	1.89
RAW BETA	2.33
Alpha(Intercept)	1.49
R2 (Correlation)	0.49
Std Dev of Error	9.04
Std Error of Beta	0.31
Number of Points	59



ADJ BETA = (0.67) * RAW BETA
+ (0.33) * 1.0

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Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2007 Bloomberg L.P.
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Published vs. synthetic beta factors

The published beta factors seen above were based on historical data. These beta factors are driven by **two** elements:

1. Business risk
2. Financial risk.

The business risk reflects factors such as the level of operational leverage (fixed costs versus variable costs); whether the business produces necessities or luxuries; whether the business's customers are public sector or private sector; how highly regulated the sector is; among other factors.

The other key element is the financial risk, or leverage. If the target capital structure that is used for the WACC calculation (see below) is different to the existing capital structure (i.e. the capital structure for the period over which the published beta factor was calculated), then the published beta factor may not be relevant for the valuation.

It is necessary to adjust the beta factor to take into account the target capital structure. This can be done in **two** stages:

1. De-lever the published beta factor to remove the effect of the existing financial leverage. This gives us an unlevered, or asset, beta factor.

Stage 1 – de-levering the beta factor

$$\beta u = \frac{\beta L}{\left[1 + (1 - T)\left(\frac{D}{E}\right)\right]}$$

Existing capital structure
N.B. market values

e.g.

$$\beta u = \frac{0.8}{\left[1 + (1 - 0.3)\left(\frac{30}{70}\right)\right]}$$

$$= 0.62$$

βu = Unlevered beta factor
βL = Levered beta factor
t = Tax rate
N.B. The above assumes the beta of debt is zero

2. Re-lever this asset beta to incorporate the target capital structure. This gives us a levered, or equity, beta factor.

Stage 2 – re-levering the beta factor

$$\beta L = \beta u \times \left[1 + (1 - T)\left(\frac{D}{E}\right)\right]$$

Target capital structure

e.g.

$$\beta L = 0.62 \times \left[1 + (1 - 0.3)\left(\frac{40}{60}\right)\right]$$

$$= 0.9$$

βu = Unlevered beta factor
βL = Levered beta factor
t = Tax rate
N.B. The above assumes the beta of debt is zero

A similar approach can be taken when valuing private companies, which do not have published beta factors. A universe of comparable listed companies can be selected, their published beta factors de-levered for their existing capital structure and re-levered for the private company's target capital structure, and an average then taken.

The version illustrated above is a slight simplification, as it assumes that the debt finance of the business has a beta factor of zero. This is consistent with the approach seen in many textbooks (e.g. Damodaran, Fernandez and others). See the "Advanced DCF Valuation" chapter of this manual for a fuller discussion of this process.

The following should clarify the alternative terminology used for beta factors:

Terminology	
Levered	Unlevered
Geared	Ungeared
Equity	Asset
Dividend	Earnings
Published	–

Weighting

Once a cost of debt and a cost of equity are established, they must be blended together to produce a weighted average cost of capital. The key question that arises is the proportions of debt and equity funding to be used for this process. The following options are available:

1. Current book values of debt and equity
2. Current market values of debt and equity
3. Target book values of debt and equity
4. Target market values of debt and equity
5. Optimal capital structure.

The merits of each of these will be addressed in turn:

1. Current book values of debt and equity

The advantage of using the current book values of debt and equity is that they are known numbers, in that they can be found in the balance sheet of the business to be valued. However, the disadvantage of this is that it shows the existing position, rather than being forward-looking.

Also, the balance sheet numbers are affected by differences in generally accepted accounting principles (GAAP). For example, under IFRS, convertible bonds are split into the debt portion, which is presented as a liability, and the equity portion, which is presented within equity. Under US GAAP, the full amount is shown as a liability (see *"Accounting and analysis for investment bankers"*, for further detail).

Different GAAP could lead to different weighting proportions being used in the WACC calculation, even though there is no underlying difference in the economic reality. Therefore, trading values must be used.

2. Current market values of debt and equity

Using market values of debt and equity avoids the accounting issues discussed above. However, this option presents other problems:

- Market values of debt and equity will only be available for listed businesses
- When they are available, they still show a current rather than a forward-looking position

- Market values suffer from volatility, which then leads to the issue of whether an average should be used. If so, what sort of average and over what period (again, historical rather than forecast)?

For these reasons, the current market values of debt and equity are often best avoided as well.

3. Target book values of debt and equity

If a forward-looking target capital structure is to be used it makes sense to think of this in market value terms (debt and equity as proportions of total enterprise value), rather than accounting, or book values.

4. Target market values of debt and equity

Using target market values of debt and equity is possible if the existing management has announced such a target or if a prospective management team envisages a particular capital structure. This is the preferred approach.

If no such announcement has been made or there is no clear preference, defaulting to the sector average capital structure can provide the solution.

A key driver of how much a business can gear up is its ability to generate cash. Since it is reasonable to expect businesses in the same sector to have similar cash-generative characteristics, their levels of leverage will converge over time.

Therefore, even if the business being valued does not currently share the sector average capital structure, it should tend towards this position in the long run.

5. Optimal capital structure

The use of an optimal capital structure has several advantages over the use of book or market values of debt and equity:

- It is forward looking
- It is not affected by accounting judgements
- It is not affected by market volatility.

However, although theories regarding the optimal capital structure do exist (e.g. those of Modigliani and Miller), calculating it in practice often proves difficult and the situation can still change over time. Also, there is no certainty that the business will follow this financial strategy.

For these reasons, the use of the optimal capital structure is also problematic.

	Book value	Market value
Current	✘	✘
Target	✘	✔
Optimal	Problematic	

Calculating the Weighted Average Cost of Capital

Once the cost of debt, the cost of equity and the weighting have been decided, the WACC can be calculated as follows:

$$WACC = Kd \times \frac{D}{D+E} + Ke \times \frac{E}{D+E}$$

$\frac{D}{D+E}$ = Proportion of finance sourced from debt

$\frac{E}{D+E}$ = Proportion of finance sourced from equity

Let's apply this to a real example:

Illustration – WACC calculation for Tesco

$$WACC = Kd \times \frac{D}{D+E} + Ke \times \frac{E}{D+E}$$

$$= 4.33\% \times 0.25 + 7.87\% \times 0.75$$

$$= 6.99\%$$

- An important aspect of the WACC analysis is also to benchmark the result against industry averages (from the companies themselves or brokers consensus)

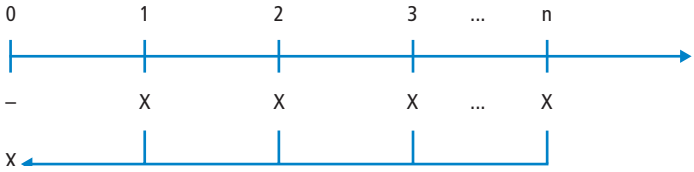
Year-end vs. mid-year discounting

Now the discount rate is established, it is necessary to consider whether it should be applied to the cash flows as at each year end or as at the mid-point of each year. Unfortunately, there is no right answer to this issue.

Valuation is always going to involve a simplification of reality. This issue is just another example of that. It is simply necessary to decide when the cash flows for year one, for example, arise.

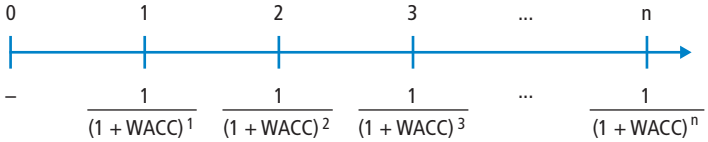
If the total cash flow for the year is not likely to be available until the end of the year, year-end discounting should be used.

Illustration – year-end discounting



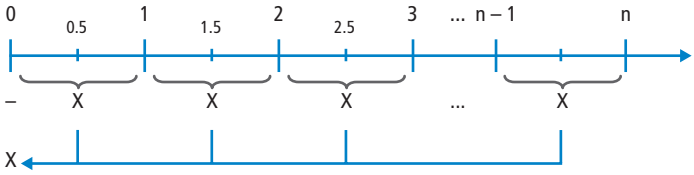
The relevant discount factors will take the following form:

Illustration – year-end discount factors



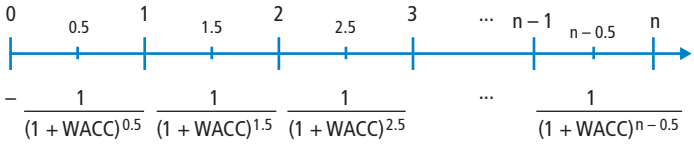
If the cash flows for the year accrue evenly over the course of the year and therefore on average accrue half-way through the year, mid-year discounting should be used.

Illustration – mid-year discounting



The relevant discount factors will take the following form:

Illustration – mid year discount factors

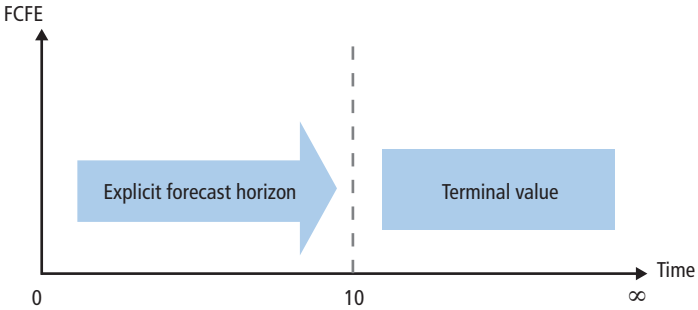


Using year-end discounting will give a lower enterprise value, as all of the future cash flows are being discounted half a year more. Conversely, using mid-year discounting will give a higher enterprise value, since all of the future cash flows are discounted half a year less.

It is possible to switch between the two approaches, depending on the circumstances of the valuation. However, in the prevailing regulatory environment, following a consistent approach to this issue is probably the wisest course of action.

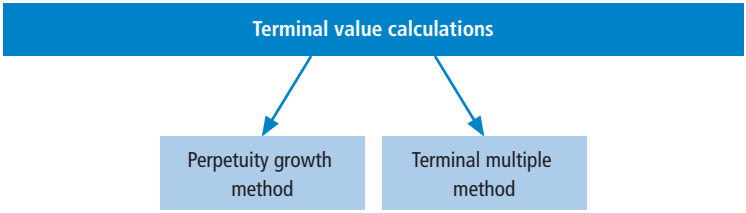
Terminal value

If the standard ten-year explicit forecast horizon is used, it is still necessary to place a value on all of the FCFE that will be generated by the business from time ten onwards, i.e. the terminal value.



There are two common methods of calculating this terminal value:

1. Perpetuity growth method
2. Terminal multiple method.



The perpetuity growth method might be considered the preferred option, as it continues the use of the DCF methodology in the FCFE model. However, the terminal multiple method is also attractive, as it is relatively quick and easy to perform and provides a useful check on the terminal value produced by the perpetuity growth method. In fact, the two methods can be used as a cross-check on each other.

Perpetuity growth method

The perpetuity growth method produces a terminal value by treating the FCFE generated during the terminal period as a perpetuity with constant growth. It is, therefore, the same approach as the Gordon Growth Model seen earlier.

This also highlights why it is important that the explicit forecast horizon continues until a steady state – a stable growth rate – has been reached. This terminal growth rate is likely to be close to the long-term sector growth rate or GDP growth rate of the economy in which the business operates.

Again, assuming the standard ten-year explicit forecast horizon, the terminal value will be calculated as follows:

$$TVp = \frac{FCFE_{10} \times (1 + g)}{WACC - g}$$

i.e. $FCFE_{11}$

e.g. $TVp = \frac{1{,}170 \times (1 + 2\%)}{8\% - 2\%}$

$= 19{,}890$

TVp = Terminal value, as calculated using the perpetuity growth method
$FCFE_{10}$ = Free cash flow to the enterprise at time ten
g = Terminal growth rate
WACC = Weighted average cost of capital

Typically, one would look at growth rates in line with inflation (e.g. 2%) or nominal GDP growth (e.g. 4.5%).
Also analysts need to cross check the perpetuity growth assumptions with the implied return on capital produced at the end of the forecasting period.

It should be noted that this formula uses the FCFE at time eleven and so produces a terminal value as at time ten, i.e. at the end of the visible forecast period.

Terminal multiple method

The terminal multiple method produces a terminal value by applying a relevant multiple to a relevant metric. Since the FCFE model is being used and an enterprise value calculated, then an EV multiple rather than an equity value multiple is used. As an EV multiple, the metric must be stated before interest, e.g. EBITA or EBITDA.

Again, if the standard ten-year explicit forecast horizon is used, then the terminal value (as at time ten) will be calculated as follows:

$TVm = EV / EBITDA \text{ multiple} \times EBITDA_{10}$

e.g. $TVm = 6.0x \times 3{,}474$
$= 20{,}844$

TVm = Terminal value, as calculated using the terminal multiple method
$EBITDA_{10}$ = EBITDA for year ten

This raises the question of the EV / EBITDA multiple to be used. Using the EV / EBITDA multiple as at time zero means applying a multiple at time zero to a metric for year ten. Intuitively, this would seem to be wrong.

More analytically, if the valuation multiple is driven by the usual three fundamentals of cash, risk and growth, then the multiple at time ten is expected to be lower than the multiple at time zero, as the business will have now passed through its higher-growth phase and will have arrived at its steady state, or constant-growth phase.

$EV / EBITDA_{10} < EV / EBITDA_0$

Cross-checking the two terminal values

The terminal values calculated by both methods can be used as a cross-check against each other. Firstly, calculating the terminal multiple implied by the terminal value arrived at through the perpetuity growth method:

If TVp = TVm

Then TVp = EV / EBITDA multiple x $EBITDA_{10}$

$$\therefore \text{Implied EV / EBITDA multiple} = \frac{TVp}{EBITDA_{10}}$$

$$\text{e.g. Implied EV / EBITDA multiple} = \frac{19{,}890}{3{,}474}$$

$$= 5.7x$$

This implied terminal multiple can then be compared with the equivalent multiple for the business at time zero and the equivalent multiple for peer companies to check whether it is reasonable.

Secondly, calculating the terminal growth rate implied by the terminal value arrived at through the terminal multiple method:

If TVm = TVp

$$\text{Then } TVm = \frac{FCFE_{10} \times (1 + g)}{WACC - g}$$

$$\therefore TVm \times (WACC - g) = FCFE_{10} \times (1 + g)$$

$$\therefore TVm \times WACC - TVm \times g = FCFE_{10} + FCFE_{10} \times g$$

$$\therefore TVm \times WACC - FCFE_{10} = TVm \times g + FCFE_{10} \times g$$

$$\therefore TVm \times WACC - FCFE_{10} = g\,(TVm + FCFE_{10})$$

$$\therefore \text{Implied growth rate } g = \frac{TVm \times WACC - FCFE_{10}}{TVm + FCFE_{10}}$$

$$\text{e.g. Implied growth rate } g = \frac{20{,}844 \times 8\% - 1{,}170}{20{,}844 + 1{,}170}$$

$$= 2.3\%$$

This implied terminal growth rate can then be compared with the long-term sector or GDP growth rate for reasonableness. This highlights the point that the key driver behind the terminal value is growth. It is within the terminal value that this key driver has its greatest impact within the FCFE model.

Calculating the present value of the terminal value

Both of the methods described above have calculated a terminal value as at the end of the explicit forecast horizon, in the example as at time ten.

In order to calculate the present value of the terminal value, these terminal values must be discounted back to time zero:

$$\text{PV of TV} = \frac{\text{TV}}{(1 + \text{WACC})^{10}}$$

Perpetuity growth method	Terminal multiple method
$\text{PV of TV} = \frac{19{,}890}{(1 + 8\%)^{10}}$	$\text{PV of TV} = \frac{20{,}844}{(1 + 8\%)^{10}}$
= 9,213	= 9,655

PV of TV = Present value of terminal value

Enterprise value

At this point, an enterprise value can be arrived at by adding together the present value of the explicit cash flows and the present value of the terminal value. It is also worth checking what percentage of the enterprise value is contributed by each of these elements:

	£	%
PV of explicit cash flows	X	X
PV of TV	X	X
EV	**X**	**100**

If it is deemed that the proportion of the enterprise value that is derived from the terminal value is too high, then there are two main options:

1. Review the key drivers of the terminal value
2. Consider lengthening the explicit forecast horizon.

Key terminal value drivers

If the terminal value has been calculated using the perpetuity growth method, the terminal growth rate should be reviewed. It may be too high.

Check the final FCFE figure, especially numbers such as capex. If the final explicit capex figure is understated, then the terminal value will be overstated. Also check implied return on capital implicit on the multiple.

If the terminal value has been calculated using the terminal multiple method, the terminal multiple should be reviewed. It may also be too high.

It is also appropriate to check the implied ROCE implicit in the multiple.

Lengthening the explicit forecast horizon

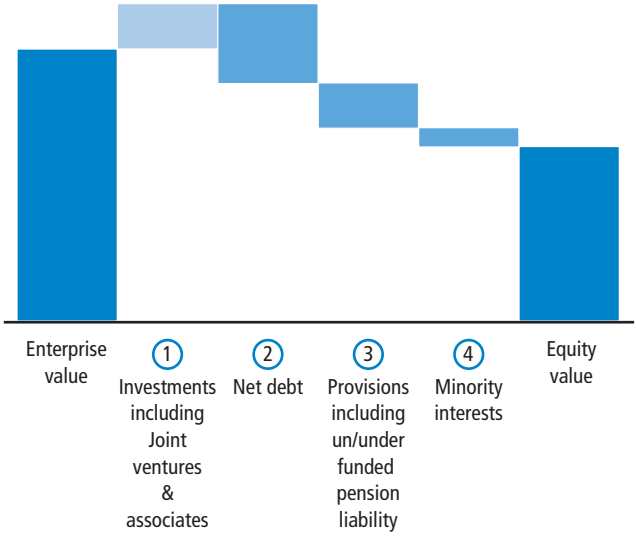
Lengthening the explicit forecast horizon will require some work in producing more discrete forecasts but will result in more of the enterprise value coming from the visible period and less coming from the less visible terminal period.

Adjusting enterprise value to equity value

The enterprise value (EV) arrived at is, effectively, the net present value of the operations of the business. This excludes the value of any financial assets the business may have and, as it is an enterprise value, has not had any financial liabilities deducted from it. By making these adjustments, the equity value is determined.

The key adjustments are as follows:

1. Add joint ventures and associates
2. Deduct net debt
3. Deduct un-funded / under-funded pension liabilities
4. Deduct minority interests.



1. Joint ventures and associates

In EBITA and, therefore, in FCFE, any share of the income and cash flows from joint ventures and associates were excluded. Therefore, the enterprise value calculated excludes the business' share of the value of those investments. This value must be added in separately at time zero.

If these investments are listed, their market value can be used. If they are not listed, and the required information is available, a separate DCF or multiple-based valuation can be performed. Otherwise, the default option is using the book value of investments in joint ventures and associates.

£m	2007
Investment in joint ventures and associates	314

Source: Tesco plc Annual Report 2007, Balance sheet, p. 46

As this is an accounting number, it is the least favoured option. This is illustrated by the following extract:

CHFm	2006
Book value	7,795
Market value	21,784

Source: Consolidated Financial Statements of the Nestlé Group 2006, Note 6, p. 30

The value of Nestlé's investment in L'Oréal is significantly understated in the balance sheet under the equity method of accounting.

2. Net debt

Net debt is calculated as follows:

Long-term debt	X
Short-term debt	X
Short-term investments	(X)
Cash and cash equivalents	(X)
Net debt	**X**

As these numbers are sourced from the balance sheet, they will be book values. For the purposes of valuation, they should be adjusted to fair, or market, values. This information should be disclosed in the notes to the financial statements under IFRS, although it may need to be updated if the balance sheet is not sufficiently recent.

Fair values

Fair values of financial assets and financial liabilities are disclosed below:

		2007
£m	Carrying value	Fair value
Primary financial instruments held or issued to finance the Group's operations:		
Short-term borrowings	(1,518)	(1,509)
Long-term borrowings	(3,999)	(3,949)
Finance leases (Group as lessor – note 31)	12	12
Finance leases (Group as lessee – note 31)	(183)	(183)
Cash and cash equivalents	1,042	1,042

Source: Tesco plc Annual Report 2007, Note 20, p. 77

By deducting net debt from the enterprise value, the effect is to add the value of the liquid financial assets and deduct the value of the standard financial liabilities.

3. Un-funded /under-funded pension liabilities

The un-funded / under-funded pension liability represents the shortfall between the market value of any pension assets that are held and the present value of the pension obligations. This represents a claim by the company

pension scheme, and / or the retired workers, on the future cash flows of the business. This is, therefore, a quasi-debt item and is treated as such.

If the corridor method of pension accounting is being used, which is often the case under IFRS, care must be taken to ensure that the correct economic deficit is extracted from the financial statements and not the balance sheet deficit.

	31 Dec 2004
Funded status	**(4,827)**
Unrecognised actuarial (gain) loss	2,593
Asset limitation due to uncertainty of obtaining future benefits	(1,186)
Net recognised liability	**(3,420)**

Source: Bayer Annual Report 2004

Also, in many countries, cash contributions into the company pension scheme, and cash payments to the retired workers, are tax deductible. This means that the economic pension deficit attracts a tax shield and should be adjusted for this, assuming the business is sufficiently profitable to take advantage of the tax deduction.

Post-tax economic deficit = Pre-tax economic deficit x (1 – t)

∴ Post-tax economic deficit = €4,827m x (1 – 30%)

= €3,379m

t = Tax rate

Most IFRS accounts will disclose the related deferred tax asset therefore there is no need to manually estimate the figure.

4. Minority interests

Since the calculation of FCFE began with EBITA, which is before the deduction of the profit attributable to the minority shareholders in group subsidiaries, the resultant enterprise value includes the minority's share of the value of those group subsidiaries. As the equity value looks at the business from the perspective of the group shareholders (i.e. the shareholders in the parent company only), the minority interest must be removed.

As with the investments in joint ventures and associates discussed above, if the subsidiaries are listed, their market value can be used. If they are not listed, and the required information is available, a separate DCF or multiple-based valuation can be performed. Otherwise, the default option is to use

the book value of minority interests. Again, as this is an accounting number, it is the least favoured option.

£m	2007
Minority interests	65

Source: Tesco plc Annual Report, 2007, Balance sheet

For completeness, the equity value can be divided by the number of shares outstanding, in order to derive an implied share price. If the business is listed, this can be compared with the actual share price, in order to calculate a control premium.

Enterprise value	**41,534**
Add: joint ventures and associates	476
Less: net debt	(4,415)
Less: pension deficit	(1,211)
Less: minority interests	(64)
Equity value	**36,320**
Number of shares outstanding	7,900
Implied share price	**460**
Current share price	415
Control premium	**10.8%**

FCFEq methodology and pitfalls

It is theoretically possible to establish a value of the firm directly as the equity level. The cashflow to be discounted would be the levered cashflows (i.e. post interest) and the discount rate would be the cost of equity. However, this is rarely done in practice due to the difficulty of forecasting forward the level of debt in the company and the consequent interest on that debt. It is much more straightforward to assume a constant debt to equity ratio in the WACC and to establish an enterprise value rather than an equity value.

5 • Dividend Discount Model (DDM)

Dividend Discount Model

The Dividend Discount Model (DDM) discounts the future dividends to arrive at equity value. Since dividends are the simplest of the cash flows that can be considered when valuing a business, the dividend discount model is consequently the simplest of the available DCF valuation models.

Despite its simplicity, it is still a valid and useful valuation technique. In the post-Enron world, dividends have become more important, with the cash payments providing proof that reported profits are genuine.

The DDM method is most often used for financial services businesses (free cash flows being notoriously difficult to calculate) and utilities, and businesses with similar characteristics. For example, the dividend discount model has been used for cable television businesses and for Eurotunnel.

Generally, the model is most appropriate for more mature firms that pay regular dividends and have stable levels of growth and leverage.

Constant dividends

If the future dividends to be paid by a business are expected to be constant and shareholders intend to hold their shares in the business in perpetuity, the equity in the business can be valued as follows:

$$MVe = \frac{D}{1 + Ke} + \frac{D}{(1 + Ke)^2} + \ldots + \frac{D}{(1 + Ke)^\infty}$$

$$= \frac{D}{Ke}$$

MVe = Market value of equity
D = Constant dividends
Ke = Shareholders' required rate of return

The following illustration demonstrates the point:

Illustration – DDM with constant dividends
MegaBank is expected to pay dividends of £150m per annum for the foreseeable future. Its shareholders require an annual rate of return of 12%. The total market value of MegaBank's equity is:

$$MVe = \frac{£150m}{0.12}$$

$$= £1,250m$$

If the total market value of MegaBank's equity was already known, the above formula could be rearranged to reveal the required rate of return of MegaBank's shareholders, as shown:

Illustration – backing out the cost of equity

$$MVe = \frac{D}{Ke}$$

$$\therefore Ke = \frac{D}{MVe}$$

$$= \frac{£150m}{£1,250m}$$

$$= 12\%$$

However, this is not a derivation of MegaBank's cost of equity. It is simply the cost of equity implied by the expected dividends and the current market value of the equity.

This implied cost of equity could, if so desired, be disaggregated further, using a model such as the Capital Asset Pricing Model (CAPM – see later). The implied beta factor could, for example, be found in this way.

While useful, this version of the DDM is somewhat unrealistic, as it assumes no growth. As this state of affairs would be unacceptable to most shareholders, we must extend the model to incorporate growth.

Constant growth in dividends

We will start by assuming that dividends are expected to grow at a constant rate, in perpetuity:

Gordon Growth Model

$$MVe = \frac{Do \times (1 + g)}{Ke - g}$$

MVe = Market value of equity
Do = Latest dividend
g = Constant growth rate of dividends in perpetuity
Ke = Shareholders' required rate of return

The following illustration demonstrates the model:

Illustration – Gordon Growth Model
Let's assume that MegaBank's most recent dividend was £150m and that they are expected to grow at 2% per annum in perpertuity.

$$MVe = \frac{£150m \times (1 + 0.02)}{0.12 - 0.02}$$

$$= £1,530m$$

Note: The annual growth of 2% adds £280m of value to the business's equity.

If the total market value of MegaBank's equity was already known, the Gordon Growth Model could be rearranged to allow us to find the growth rate implied in the value, as shown:

Illustration – backing out the implied growth rate

$$MVe = \frac{Do \times (1 + g)}{Ke - g}$$

$$\therefore MVe \times (Ke - g) = Do \times (1 - g)$$

$$\therefore MVe \times Ke - MVe \times g = Do + Do \times g$$

$$\therefore MVe \times Ke - Do = MVe \times g + Do \times g$$

$$= g\,(MVe + Do)$$

$$g = \frac{MVe \times Ke - Do}{MVe + Do}$$

$$= \frac{£1,530 \times 0.12 - £150m}{£1,530 + £150m}$$

$$= 2\%$$

Applying this process to a real example, substituting the share price for the total market value of equity:

Illustration – HSBC – backing out the implied growth rate

$$g = \frac{\text{Share price x Ke} - \text{Do}}{\text{Share price} + \text{Do}}$$

Banks

			... 52 week ...				Vol
	Price	Chng	High	Low	Yld	P/E	'000s
Alnce&Lei	492	-36	£12.10	428	11.2	8.0	25,406
Alliedlr €	£10.46	+0.40	£16.40	923.63	5.4	5.5	4,660
Anglolr €	677.06	-10.56	£12.18	594.83	2.2	6.8	3,359
ANZ A$	£10.36	-0.30	£14.05	£10.32	8.8	10.1	9,422
BankAM $	22.13	+0.18	£27.68	£16.96	5.7	12.9	5,765
Banklre €	713.67	+1.87	£12.68	£633.60	6.7	4.9	3,473
BkNvas C$	£24.50	+0.23	£24.53	£21.46	3.7	12.0	968
Barclays	490	+13	794	396	6.9	7.6	95,696
BcoSantdr	878	-12	£10.87	776	5.5	9.5	289
Brdford&B	181	-1.25	£473.75	169	11.6	4.7	8,611
Canlmp C$	£33.40	-0.13	£49.98	£31.99	5.0	7.1	943
EFG Intl SFr	£16.05	+0.40	£25.03	£13.47	0.9	18.9	155
EsprtoS €	£13.90	-0.28	£23.80	£13.44	2.2	13.7	0
HBOS	646.50	-12.50	£11.76	587	6.9	6.0	42,311
HSBC	745.50	-10.50	972	676	6.6	9.3	36,756
LlydsTSB	428	-4	622	354	8.1	7.7	47,113
MitsubTk Y	438.34	-19.63	760.01	411.61	1.5	16.7	60,118
NrthnRck	96	–	£12.29	52.50	29.6	–	2,061
RylBkC C$	£25.61	–	£28.41	22.48	3.8	12.1	1,662
RBS	363.25	-3.50	724.93	317	8.9	5.1	67,247
StandCh	£15.58	-0.30	£19.75	£13.21	2.7	17.1	7,967
Trnto-Dom C$	£33.92	+0.46	£38.08	£30.32	3.3	12.1	856
Westpc A$	£10.57	-0.35	£13.82	£10.45	8.2	13.1	11,141

Source: www.ft.com 15/02/08

Share price = 745.5p

Ke = 4.5% + 1.1 x 5% = 10% (using CAPM – see later)

Do = Dividend yield x share price

= 6.6% x 745.5p

= 49.2p

$$\therefore g = \frac{745.5\text{p} \times 10\% - 49.2\text{p}}{745.5\text{p} + 49.2\text{p}}$$

= c. 3.2%

The implied growth rate can then be disaggregated using the following growth model:

g = r x b

r = Return on capital reinvested
b = Reinvestment rate

The growth model shows that growth comes from reinvesting some of the profits and then generating further returns on the capital reinvested. The following examples illustrate this:

Illustration – r x b model
Assuming £100m is invested at time zero:

A

Return on investment	10%	
Reinvestment rate	50%	

Time	**0**	**1**	**2**
Investment	£100m →	£110m	
Withdrawn		(£5m)	
		£105m →	£115.50m
Withdrawn			(£5.25m)
			£110.25m

The investment has grown at 5% p.a. (10% x 50%)

B

Return on investment	10%	
Reinvestment rate	100%	

Time	**0**	**1**	**2**
Investment	£100m →	£110m	
Withdrawn		–	
		£110m →	£121m
Withdrawn			–
			£121m

The investment has grown at 10% p.a. (10% x 100%)

The more that is reinvested and the greater the return on that reinvestment, the greater the growth.

Returning to the real example:

Banks

			... 52 week ...				Vol
	Price	Chng	High	Low	Yld	P/E	'000s
Alnce&Lei	492	-36	£12.10	428	11.2	8.0	25,406
Alliedlr €	£10.46	+0.40	£16.40	923.63	5.4	5.5	4,660
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Westpc A$	£10.57	-0.35	£13.82	£10.45	8.2	13.1	11,141

Source: www.ft.com 15/02/08

Illustration – disaggregating the implied growth rate

$$\frac{\text{Dividend}}{\cancel{\text{Price}}} \times \frac{\cancel{\text{Price}}}{\text{Earnings}} = \frac{\text{Dividend}}{\text{Earnings}}$$

$$\text{Dividend Yield} \times \text{P/E Ratio} = \text{Payout Ratio}$$

$$6.6\% \times 9.3 = 61.4\%$$

If payout ratio = 61.4%, reinvestment rate = 1 – 61.4% = 38.6%

Rearranging the simple growth model, the implied return on equity can be backed out:

$$g = r \times b$$

$$\therefore r = \frac{g}{b}$$

$$= \frac{3.2\%}{38.6\%}$$

$$= \text{c. } 8.3\%$$

This implied return on equity can be compared with historical data and expectations in order to form a view on the current valuation of the business's shares.

The advantage of this constant growth model is that it highlights the **three** fundamentals that lie behind any valuation:

1. Cash
2. Risk
3. Growth.

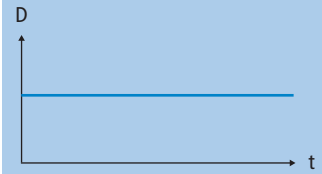
The more cash a business can generate, the less risky those cash flows and the more those cash flows are likely to grow, the more valuable that business will be, and vice versa.

One disadvantage of this model is that it does not work if the growth rate is higher than the cost of equity (the denominator, and consequently the value, become negative). Another is that it can be somewhat unrealistic. In the example, an implied growth rate of 3.2% per annum in perpetuity is debatable. These problems can be remedied by extending the model to a two-stage growth model.

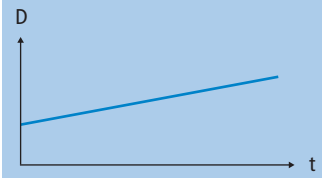
Two-stage growth model

The first model assumed no growth in dividends. The second model assumed constant growth. This third version assumes two stages of growth in dividends: a shorter higher-growth stage followed by a longer lower-growth stage.

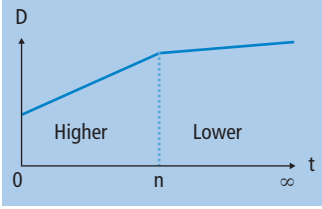
Constant dividends



Constant growth in dividends



Two stages of growth in dividends



The formula for the two-stage growth model can be written as follows:

MVe = Higher-growth stage + Lower-growth stage

Higher-growth stage

$$\underset{0 \rightarrow \infty}{\frac{Do \times (1 + G_{HIGH})}{Ke_{HIGH} - G_{HIGH}}} - \underset{n \rightarrow \infty}{\frac{\frac{Do \times (1 + G_{HIGH})^{n+1}}{Ke_{HIGH} - G_{HIGH}}}{(1 + Ke_{HIGH})^{n}}}$$

Lower-growth stage

$$\frac{\frac{Dn \times (1 + G_{LOW})}{Ke_{LOW} - G_{LOW}}}{(1 + Ke_{HIGH})^{n}}$$

In the higher-growth stage, the first term calculates a perpetuity with constant (high) growth starting at time zero. The second term removes all of the value created after time n, the end of the higher-growth stage. This leaves just the value created during the higher-growth stage.

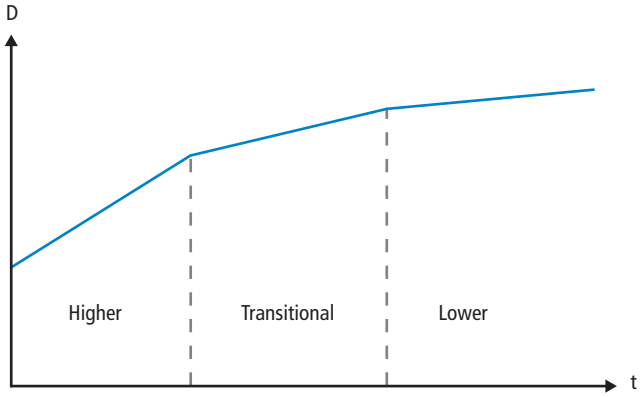
In the lower-growth stage, the term calculates a perpetuity with constant (low) growth, starting at time n. This is then discounted back to time zero.

If applied to the real example, assuming a 5 year higher period at 4% and then a lower growth period of 1%:

		Price	%
Higher-growth period		**209p**	**28%**
Dividend	49.3p		
Cost of equity	10%		
Growth	4%		
No. of years	5 years		
Lower-growth period		**538p**	**72%**
Dividend	77.2p		
Cost of equity	10%		
Growth	1%		
Total		**747p**	**100%**

Obviously, the DDM can be extended further to a three-stage model (with, for example, a higher-growth phase, then a transitional phase and finally a lower-growth phase) and beyond.

Three stages of growth



This approach can also be applied to the terminal phase of the full-blown free cash flow DCF models, if the business in question has not reached a steady state of growth by the end of the visible forecast period (see later).

6 • Advanced DCF valuation

Introduction

The subject matter of advanced DCF is no longer the sole province of business school academics, but is a live issue in the current M&A market place.

Given that the academics are still debating many of the issues there are often no 'right or wrong' answers to many of the topics – however it is important to establish a consistent approach and to be conversant with the relevant issues.

A number of the topic areas interrelate, in particular, delevering betas, the appropriate WACC formula and the APV calculations. The aim is for consistency and a robust approach.

Other areas such as terminal growth rates, implied returns and cyclicality are also interrelated and will be treated in a similar way.

Delevering betas

The published beta obtained from most data sources will be a levered beta – that is to say it represents the systematic business risk of the share, plus the finance risk associated with the company's level of debt finance. Delevering the beta involves removing the finance risk element and creating a synthetic or artificial beta which simply reflects the systematic business risk of the company on the assumption that it was all equity financed.

The key reason for doing this is to establish a comparable universe when creating a **synthetic beta for a company**. This may be because the company doesn't have a beta (IPO valuation or lack of reliable data in the country) or it may be because the banker feels that a beta based on comparable data is more reliable in the long term and less subject to short term market noise than a beta selected from a data provider.

Creating a synthetic (delevered beta)

Many investment banks now have standard models for DCF (free cash flow) valuations which include, as part of the model, a delevering calculation. This will comprise a comparable universe with each company contributing a levered beta into the equation. These levered betas are then delevered to create an underlying delevered comparable beta.

This comparable delevered beta is then relevered according to the required gearing ratio for the target company. The resulting beta is then inserted into CAPM to produce a cost of equity, which is then inserted into a second formula to create a WACC.

There are a number of (often interrelated) issues to consider in this process:

1. Selection of the comparable universe
2. The delevering formula
3. The averaging process
4. The relevering formula
5. The WACC formula.

Selection of the comparable universe

The usual comparable issues will be considered – but since the aim is to determine an underlying industry beta, greater weight will obviously be placed on the nature of the business than on growth profiles, size of company, geographical location, etc.

The delevering formula

There are a number of different formulae to be considered when delevering a beta and these can be reviewed in the academic literature – the following website is a useful start:
http://ideas.repec.org/a/eee/jfinec/v73y2004i1p145-165.html

The theories and their proof can become extremely mathematical with most work centering around the valuation of the tax shield, in particular the level of risk associated with it, and the stability of the long term relationship between the equity and debt of the company in question.

Some of the most commonly expressed formulae are:

$\beta L = \beta u + (\beta u - \beta d)(D / E)(1 - T)$	(ABN approach)
$\beta L = \beta u + \beta u (D / E)(1 - T)$	(Damodaran)
$\beta L = \beta u (1 + D / E)$	(No tax)
$\beta L = \beta u + (D / E)(\beta u - \beta d)$	(Harris Pringle)
$\beta L = \beta u + (D / E)(\beta u - \beta d)[1 - T\,Kd / (Kd - g)]$	(Myers)
$\beta L = \beta u + (D / E)(\beta u - \beta d)[1 - T\,Kd / (1 + Kd)]$	(Miles-Ezzell)
$\beta L = \beta u + (D / E)[\beta u - \beta d + (T\,Kd / Pm) - VTS\,(Ku - g) / (D\,Pm)]$	(Modigliani and Miller)

The above are taken from IESE CIIF working paper 488 revised May 2006 – *"Levered and unlevered Beta"*, by Pablo Fernandez.

The symbols and abbreviations are:

βd = Beta of debt
βL = Beta of levered equity
βu = Beta of delevered equity = Beta of assets
D = Value of debt
E = Value of equity
g = Constant growth rate
Ku = Cost of delevered equity (required return to delevered equity)
Ke = Cost of levered equity (required return to levered equity)
Kd = Required return to debt = Cost of debt (pre tax)
Pm = Market risk premium = Rm – Rf
T = Corporate tax rate
VTS = Value of the tax shields

At Rothschild it makes sense to start with cost of capital research from ABN AMRO equity research (given the historic AAR JV) and to then consider possible issues (a more detailed review would require an entire text in its own right).

The delevering formula used is:

$$\beta u = \frac{\left[\beta L + \beta d \left(\frac{D}{E}(1 - T)\right)\right]}{\left(1 + \frac{D}{E}(1 - T)\right)}$$

This is a rearranged version of the first formula making the asset (delevered) beta the subject of the formula.

Note that this is the same as the Damodaran formula, if the beta of debt is assumed to be zero.

Many bankers make this simplifying assumption for investment grade companies.

A key underlying assumption is that there is a fixed relationship between the book values of debt and equity (rather than the less realistic assumption as to a fixed market value relationship).

McKinsey (Valuation) also cites this formula in appendix D to the fourth edition with the underlying assumptions being:

- Dollar level of debt is constant (similar but not identical to the above)
- Debt is risky (hence the debt beta)
- The tax shields have the same risk as debt (rather than the same risk as operating assets).

The assumptions can of course be challenged, but are not unreasonable.

If the underlying academic assumptions are accepted, the next hurdle is the practical issue of establishing the inputs for the formula. These are:

The equity (levered) betas to be delevered need to be sourced

The ABN team produce their own beta estimates based on a 5 year monthly observation period regressed against a global market index using the FTSE world index as a proxy for the global market portfolio.

The observed beta (raw) is adjusted based on the Blume adjustment:

$$\text{Adjusted beta} = \frac{2}{3} \times \text{raw} + \frac{1}{3} \times 1$$

There are a number of immediate practical issues to consider:

Issue	Resolution
Thin trading in shares	Companies removed if a period of no trading for 2 months
Dealing with outliers	Companies discarded if beta is negative or over 3
The estimation period	Difficult to resolve but it is a balance between more data and data becoming old
Reference day	A recent paper (Prof Daniela Acker, Bristol University) shows the actual day of reference (i.e. the date within the month selected as the reference point for measuring the relative change) will have a significant impact on the outcome

From the above there is already a degree of imperfection entering the analysis. This should be borne in mind when considering a 'right' answer to the cost of capital problem.

The debt betas need to be calculated and sourced

Academically the debt beta can be derived by decomposition of the debt premium for a company. This will involve separate identification of:

1. Default premium
2. Non credit risk factors such as liquidity, tax etc.
3. Systematic risk.

It would appear that academic research in this area is thin.

An alternative would be to regress bond returns against a market index – once again there is a distinct lack of data.

In practice the approach often used is …

βd = Debt premium / (Rm – Rf)

This in turn requires estimates for the risk-free rate, Rf.

Rf

The ABN research uses 10 year government bond yields for the country in which the company's cash flows are denominated. These are adjusted if the rates are considered to be abnormally low (further subjectivity).

Rm – Rf = Market risk premium

As always a subject for debate. ABN uses a global premium extracted from the Global Investment Returns Yearbook (GIRY) produced by Dimson, Marsh and Staunton at the London Business School (LBS).

Debt premium

ABN derive their debt premiums *"based on the cost of publicly traded debt and/or the cost of existing bank facilities and the company's credit outlook. The analyst estimates the interest margin or debt premium the company pays over the risk-free rate. If there is a significant difference between the current debt and the target debt level then an estimate of the premium at the target level is used."* (Source: ABN beta book)

Once again there is a large amount of subjectivity and potential noise entering into the calculation.

The leverage ratio needs to be estimated

D / E

This can be calculated in a number of ways. The ABN research analysis looks at the likely future leverage of the company in question. This can of course be quite different from the existing leverage of the company.

Corporate tax (T)

This is the expected effective corporate tax rate over the forecast period. Once again this may need to be estimated.

The averaging process

The ABN team delevers the betas to create an industry average delevered beta. For the averaging calculation, the individual betas are weighted according to the relative market capitalisation of the stocks. Once again the calculation will be subject to the state of the individual companies and the market at a particular moment in time.

The releveraging formula

The target stock has a synthetic beta calculated for it based upon relevering the underlying asset beta for the sector.

ABN uses the formula:

$$\beta L = \beta u + (\beta u - \beta d)\, D / E\, (1 - T)$$

All of the issues surrounding the formula have been covered previously. The obvious point is that it is consistent with the delevering formula and the tax rate used is the expected effective tax rate for the company in question.

Once again the leverage is based on the analyst's view of the forecast debt/equity ratio for the company.

The WACC formula

There are two main routes for calculating the WACC:

1. Weighting the cost of equity and cost of debt
2. Using the Modigliani and Miller formula.

The market weighting version

By far the most popular method is the simple weighting formula with the WACC calculated as:

$$WACC = Ke \times E / (D + E) + Kd \times (1 - T) \times D / (D + E)$$

This requires both Ke and Kd to be calculated.

Cost of equity, Ke

This is calculated using CAPM:

$$Ke = Rf + \beta L \times (Rm - Rf)$$

Global estimates for the equity market premium and the local risk-free rate are used.

The equity (levered) beta, βL, is calculated using the formula above.

Cost of debt, Kd

The cost of debt is calculated using the formula:

$$Kd = Rf + \beta d (Rm - Rf)$$

Note: this is the same as Kd = Rf + debt premium, which is the most commonly used version.

WACC

The formula is:

$$WACC = Ke \times E / (D + E) + Kd \times (1 - T) \times D / (D + E)$$

The weightings are based on the analyst's leverage forecast for the company in question.

The above calculation is familiar and straightforward; however, the weighting proportions can be debated.

Weighting proportions

The proportions of equity and debt used in the WACC should be based on market values. However, there are a number of alternatives as regards market values:

Current market value

This has the advantage of being empirically correct.

However the current position may be atypical. Also if the WACC is being used to calculate a market value there is a degree of circularity in basing one of the inputs on current market value.

When using a WACC based on current market values to calculate an implied enterprise value it would make sense to deduct the current market value of the net debt when moving from enterprise to equity value.

Optimum leverage ratio

Using either Modigliani and Miller (M&M) or an empirical model, it is possible to derive the optimal capital structure for the company's WACC. This capital structure can then be used in the WACC calculation.

Obviously this assumes that the company can and will move towards this optimum position.

When using a WACC based on an optimal capital structure to calculate an implied enterprise value it would make sense to deduct the same proportion when moving from enterprise to equity value.

Target leverage ratio

The board may have stated targets for their long term leverage. If these are publicly stated and deemed attainable, then it would make sense to use this ratio in creating the WACC.

Alternatively, the target leverage ratio is calculated by the research analyst (per ABN AMRO).

The target leverage ratio approach creates an issue when moving from enterprise value to equity value in a DCF. The issue is that the enterprise value is based on the capital structure created for the WACC, but the net debt deduction to establish the equity value is the current market value of

the net debt which could be quite different to a deduction based on the target leverage ratio, leaving the resulting equity value open to question.

Industry average

In certain circumstances (for example in IPOs) there may be a lack of available data.

In these instances it can be assumed that the company will tend towards the industry average debt to equity ratio. This can be used in a one-stage WACC model or as the stable ratio in a two-stage or three-stage model.

Modigliani and Miller version

Modigliani and Miller, two of the most eminent and respected of all financial strategists, created a model of leverage based on their famous underlying assumption of the 'perfect capital market'.

Their work, spanning three decades, provides a comprehensive coverage of the leverage debate. Their formula for deriving the WACC is:

$WACC = Ku \times (1 - T \times D / (D + E))$

Where Ku = delevered cost of equity

A worked example

Aiming to calculate WACC

Assume:

D = 200
E = 300
T = 30%
$\beta u = 0.9$
Rf = 5%
EMP = 4%
Debt premium 1.5%

Following ABN to find βL

$\beta L = \beta u + (\beta u - \beta d) D (1 - T) / E$

This requires βd

βd = Debt premium / (Rm – Rf)

$\beta d = 0.015 / 0.04$
$\beta d = 0.375$

βL = 0.9 + (0.9 – 0.375) x 200 x (1 – 0.3) / 300

βL = 1.145

So Ke = Rf + βL (Rm – Rf)

Ke = 5% + 1.145 x (4%)

Ke = 9.58%

To find Kd

Kd = Rf + βd (Rm – Rf)

Kd = 5% + 0.375 x 0.04

Kd = 6.5% (needs to be post tax in the WACC formula)

The WACC

Based on market weighting

9.58% x 300 / 500 + (6.5% x 0.7) x 200 / 500

= 7.568%

Based on M&M

WACC = Ku x (1 – T x D / (D+E))

To find Ku

= Rf + βu (Rm – Rf)

= 5% + 0.9 x (4%)

Ku = 8.6%

So WACC

= 8.6% x (1 – 30% x 200 / 500)

= 7.568%

The above relies on the pre-stated academic assumptions. These may be challenged but given the 'noise' attached to establishing the data and the fact that the WACC is always subject to sensitivity analysis in DCF valuations it would appear academically safe to follow the ABN approach providing one is aware of the underlying assumptions.

The above will still work starting (as happens in practice) with the observed equity beta.

The above is shown in the text box on the Rothschild standard DCF model allowing flexibility as the case requires.

Beta

1. If the company has a listed beta, then this figure can be chosen as the basis for the cost of equity and so WACC
2. If a comparable beta is to be used, then different methods can be adopted to find the appropriate equity beta:
   a. ABN approach

      $\beta L = \beta u + (\beta u - \beta d) \times D \times (1 - T) / E$

   b. Damodaran approach (per above assuming Beta of debt is zero).

      This assumption is made in the model

      $\beta L = \beta u + (D / E) \times \beta u (1 - T)$

   c. Untaxed beta approach

      $\beta L = \beta u \times (1 + D / E)$

Where:

βL = target's equity levered beta
βu = ungeared comparable beta
T = target's corporate tax rate
D = market value of target's debt
E = market value of target's equity

Cost of equity

In all cases the cost of equity is calculated as:
$Ke = Rf + \beta L \times EMRP$

Where:

Ke = target's cost of equity
Rf = risk-free rate
βL = equity beta calculated above
EMRP = equity market risk premium

WACC

There are 2 approaches to the WACC calculation:

a. Modigliani and Miller approach:

$$WACC = Ku \times \left(1 - T \times \frac{D}{D + E}\right)$$

b. Weighted average approach:

$$WACC = Ke \times \frac{E}{D + E} + Kd \times (1 - T) \times \frac{D}{E + D}$$

Where:

Ku = target's delevered cost of equity
Ke = target's levered cost of equity
Kd = target's pre tax
T = target's corporate tax rate
D = market value of target's debt
E = market value of target's equity

APV valuation

The Adjusted Present Value (APV) valuation methodology has long been a favourite for academics. More recently, however, it has become a part of mainstream valuation analysis.

The principle is to value the operations of the business and then separately to value the benefits of financing. This allows a much more flexible approach to financing than the plain vanilla DCF which assumes a constant (target) capital structure throughout the forecast period.

The mechanics are straightforward:

1. Discount the free cash flow (delevered) at the delevered cost of equity to establish a present value
2. Then discount the relevant financing cash flows at an appropriate discount rate to establish their present value
3. Add the two present values together to arrive at the enterprise value.

In practice this is quite frequently simplified into:

$$\text{Adjusted present value} = \begin{array}{c}\text{Enterprise value if the company was all equity financed} \\ + \\ \text{present value of the tax shields}\end{array}$$

The above ignores, as immaterial, other incremental financing flows (fees, distress costs, etc.)

The APV requires an understanding of:

1. Free cash flow (delevered)
2. Tax shield
3. Delevered cost of equity Ku
4. Discount rate for tax shield.

Free cash flow (delevered)

This is the same as the normal definition when discounting at the WACC to establish an enterprise value.

Tax shield

This will be the interest payments on debt multiplied by the firm's effective corporation tax rate.

Delevered cost of equity, Ku

The calculations required for this are based on the M&M theories of the firm.

The summarised position is that the total risk of the company's assets must equal the total risk of the financial claims against those assets.

So:

$$\underbrace{\frac{Vu}{Vu + Vtxa}\,Ku}_{\text{Operating Assets}} + \underbrace{\frac{Vtxa}{Vu + Vtxa}\,Ktxa}_{\text{Tax Assets}} = \underbrace{\frac{D}{D + E}\,Kd}_{\text{Debt}} + \underbrace{\frac{E}{D + E}\,Ke}_{\text{Equity}}$$

Where:
Vu = Enterprise value if company was all equity financed
Vtxa = PV of tax shields
Ktxa = Appropriate discount rate for tax shields
Kd = Post tax cost of debt

To establish Ku an assumption about the risk associated with the tax shield is required.

1. Assuming that the risk of the tax shield equals the risk of the operating assets the equation simplifies to:

$$Ku = \frac{D}{D + E}\,Kd + \frac{E}{D + E}\,Ke$$

2. Assuming the risk associated with the tax shield equals the risk of debt then the equation becomes (after a fair amount of re-arrangement and substitutions):

$$Ku = \frac{D - Vtxa}{D - Vtxa + E}\,Kd + \frac{E}{D - Vtxa + E}\,Ke$$

This second equation can be further refined (based on the assumption of the company maintaining a constant level of debt) with the value of the tax shield being D x T so Ku becomes:

$$Ku = \frac{(1 - T)\,D}{(1 - T)\,D + E}\,Kd + \frac{E}{(1 - T)\,D + E}\,Ke$$

This links back to the ABN formula for the delevering of the beta.

An alternative route to calculating Ku is to use CAPM with the industry delevered beta:

$Ku = Rf + \beta u \times (Rm - Rf)$

Both cases start with an empirically observed number (Ke or βL) and apply the relevant delevering formula.

Which formula to select

Once again there is academic debate as to the most appropriate formula to use – the following should be borne in mind:

1. The equations are based on the M&M assumptions which simply don't apply in the real world
2. Imperfections exist in collating the data
3. Flexibility: for example, if the company is managing a target capital structure, the value of the tax shield is more likely to have a risk profile aligned with the operating assets. If the company is managing a high debt level (a private equity transaction over infrastructure assets), then the value of the tax shield will be aligned with the debt level being maintained and the final formula is appropriate.

Discount rate for the tax shield

The appropriate discount rate will depend on the risk profile of the tax shield.

The possible options are:

1. The risk-free rate (Rf)
2. The pre-tax cost of debt (Kd)
3. The delevered cost of equity (Ku)
4. The levered cost of equity (Ke)
5. A combination of the above.

There are two issues at this point – what discount rate makes intuitive sense and ensuring consistency with the assumptions made in deriving the Ku that has been used in discounting the free cash flows.

However, given that the Ku calculation was based partially on the underlying assumption regarding the risk associated with the tax shield, it would make sense to follow the same assumption with the actual discounting of the tax shield.

Provided this consistency is maintained it would be reasonable to suggest that the APV calculation be based on a case by case basis rather than having one overriding assumption.

Worked example

Summary Balance sheet	0	1	2	3	4	5	6
Net working capital	640	688	824	880	898	916	
PPE	2,560	2,880	3,680	4,160	4,661	5,171	
Accum depn	–	320	720	1,152	1,593	2,042	
Net fixed assets	2,560	2,560	2,960	3,008	3,068	3,129	
Total assets	**3,200**	**3,248**	**3,784**	**3,888**	**3,966**	**4,045**	
Debt	2,400	2,400	2,400	2,400	2,400	2,400	
Equity	800	848	1,384	1,488	1,566	1,645	
Total liabilities & equity	**3,200**	**3,248**	**3,784**	**3,888**	**3,966**	**4,045**	
Income statement							
EBIT		672	1,088	1,184	1,224	1,248	
Interest payments		192	192	192	192	192	
PBT		480	896	992	1,032	1,056	
Tax		168	314	347	361	370	
PAT		**312**	**582**	**645**	**671**	**686**	
Cash Flow							
EBIT		672	1,088	1,184	1,224	1,248	
Add depn		320	400	432	441	449	
Less increase in working capital requirement		-48	-136	-56	-18	-18	
Less investment in fixed assets		-320	-800	-480	-501	-510	
Tax (adjusted for interest tax shield)		-235	-381	-414	-428	-437	
FCF		**389**	**171**	**666**	**718**	**732**	**747**
Tax shield		67	67	67	67	67	67
g	2%						
βu	1						
Rf	6%						
Kd	8%						
EMRP	4%						
Ku	10%						
FCF (discounted at Ku)		353	141	500	490	455	
Tax shield (discounted at Kd)		62	58	53	49	46	
Total PV of above		**416**	**199**	**553**	**540**	**500**	**2,208**
Terminal value of FCF						9,337	
Present value of Terminal value of FCF							**5,797**
Terminal value of Tax shield						840	
Present value of terminal value of tax shield							**572**
Enterprise value							**8,577**
Debt							**2,400**
Equity value							**6,177**

The above is based on the assumption of a constant debt level with the tax shield discounted at the pre tax cost of debt.

Terminal value and growth rates

The terminal value calculation is the continuing or ongoing value of the business after the discrete or visible year by year forecast period.

It is a critical element of the DCF valuation occasionally accounting for over 100% of the total value.

Often it is captured in a single one stage calculation (which can be extended to cover two or even three stages).

There are a number of different ways of performing the calculation. The most well known ones are:

1. The (McKinsey) value drivers method
2. FCF method
3. Exit multiple.

The McKinsey value drivers method

Whilst this is the least used in practice it is the most robust method and will serve as a platform to critique the more popular practical approaches.

The basic formula for estimating the Terminal Value (TV) is:

$$TV = \frac{NOPLAT_{T+1}\left(1 - \frac{g}{RONIC}\right)}{WACC - g}$$

Where:

NOPLAT = Net operating profit less adjusted taxes (adjusted for interest tax shield)

$NOPLAT_{T+1}$ = Normalised level of NOPLAT in the first year after the explicit forecast period

g = Expected growth rate in NOPLAT in perpetuity

Note: As growth (g) comes from the return generated on new invested capital (RONIC), g / RONIC is one way of expressing the new investment rate (the proportion of NOPLAT reinvested)

RONIC = Expected rate of return on new invested capital

WACC = Weighted average cost of capital

For example:

NOPLAT = 1,000
WACC = 8%
RONIC = 12%
Net new investment = 30% (proportion of NOPLAT reinvested)
FCF = 700 (NOPLAT less net new investment)
Growth = 3.6% (based on RONIC x new investment rate)

The TV would be:

= 1,000 x (1 + 0.036) x [1 – 0.036 / 0.12] / (0.08 – 0.036)
= 16,481.82

It is interesting to see what happens when the RONIC falls to the WACC, classically assumed at the end of the competitive advantage period.

Using the numbers above, but with RONIC = 8%
Growth will fall to 2.4%

The TV would be:

= 1,000 x (1 + 0.024) x [1 – 0.024 / 0.08] / (0.08 – 0.024)
= 12,800

The key point to observe here is this is the same as:

NOPLAT (T + 1) / WACC

= 1,000 x (1 +0.024) / 0.08
= 12,800

As McKinsey correctly states: "The fact that the growth term has disappeared from the equation does not mean that nominal growth in NOPLAT will be zero. The growth term drops out because new growth adds nothing to value as the return associated with the growth equals the cost of capital. The formula is sometimes interpreted as implying zero growth (not even with inflation), but this is not the case."

The FCF method

This is most commonly used in practice and is:

FCF (T + 1) / (WACC – g)

Using the numbers above firstly with RONIC at 12% and growth at 3.6% we find:

700 x (1 + 0.036) / (0.08 – 0.036)
= 16,481.82

the same as the value drivers result.

And with RONIC at 8%

700 x (1 + 0.024) / (0.8 – 0.024)
= 12,800

the same as the value drivers result.

The issue of difference only arises in the FCF valuation when growth is changed (often in sensitivity tables) without reference to the associated returns or required levels of reinvestment.

Taking the above numbers if we keep RONIC at 12% and then arbitrarily increase the growth rate to 5% – the FCF TV becomes:

700 x (1 + 0.05) / (0.08 – 0.05)
= 24,500

The value drivers formula gives us:

1,000 x (1 + 0.05) x [1 – 0.05 / 0.12] / (0.08 – 0.05)
= 20,416.67

In effect the formula is automatically correcting for the required retention needed to deliver a 5% growth rate:

i.e. if RONIC x retained investment = growth then
g / RONIC = the retained investment level

In this instance 0.05 / 0.12 = 41.67%, thereby reducing the cash to be discounted and the terminal value.

The danger therefore lies in the FCF TV approach overlooking the need to change the FCF to reflect the implied investment required to deliver a new growth rate.

The multiple approach

One of the most common methods of estimating terminal value is to apply an exit multiple – usually to an income statement line item.

The multiples seen most often are:

EV / EBIT

EV / EBITA

EV / EBITDA

The creation and application of these multiples is comprehensively covered in the chapter on comparable company analysis.

There are, however, interesting considerations when using this technique to establish the TV.

Most of these surround the implied growth rate used in the multiple.

If the multiple is simply selected from a contemporary comparable universe and applied to future cash flows (maybe in 10 years time) then the assumption is that the growth potential of the existing universe is the same as the growth profile of the target company in 10 years time.

Ideally the comparable company selected should have the same growth profile (now) as the target will have in the future (10 years on). In practice this is difficult to establish and bankers will fall back on existing multiples.

One key issue is to understand what Professor Aswath Damodaran refers to as the anatomy of the multiple – essentially the drivers of the multiple.

Working with perpetuities

FCF / (WACC – g) = EV

So EBITA x (1 – T) x [1 – g / RONIC] / (WACC – g) = EV

where, as before, g / RONIC is the reinvestment proportion.

If the second equation is divided by EBITA:

EV / EBITA = (1 – T) x [1 – g / RONIC] / (WACC – g)

The benefit of this is that it allows a 'back testing' of the exit multiple used.

Illustration:

Assume: An exit multiple of 10.5 (EV / EBITA).

Tax rate = 30%

WACC = 8%

Growth rate = 3%

The formula can be rearranged to find the implied RONIC in the multiple.

10.5 = 0.7 x [1 – 0.03 / RONIC] / (0.08 – 0.03)

Using goal seek or similar, the implied RONIC is 12%.

This can be compared with the company's actual RONIC to check the soundness (or otherwise) of the EV / EBITA estimate of 10.5.

The above analysis is based on a single long term growth rate. It is possible to extend this to cover 2 or even 3 stage growth periods.

International cost of capital

The key issues of cost of capital, cash flows and exchange rates are interrelated. There is no consensus on the correct solution to the problems, but it is important to establish consistency in the methodology used to value international assets.

General approach

Assuming the UK to be the 'home' country, the most frequently used methods are:

- Forecast cash flows in nominal terms in the overseas currency
- Forecast exchange rates, based on purchasing power parity (inflation differential)
- Translate cash flows into UK currency
- Discount at a WACC incorporating a political risk premium.

Using this approach the practicalities of forecasting the cash flows and the exchange rates are problematic. However, the most controversial issue is the incorporation of the political risk premium into the WACC.

WACC

Taking the traditional approach to WACC, there are three components:

- Ke calculated using CAPM
- Kd calculated using risk-free rate plus a credit premium (adjusted for tax shield)
- Weighting the Ke and Kd.

Ke

The most frequently used approach is to add the political risk premium to one element of the CAPM. There are many variations on this theme.

The CAPM has three components:

- Rf
- Beta
- EMP.

Rf – the risk-free rate

The risk-free rate is based on:

- Bonds (shorter term instruments are possible, but less frequently used)
- Government bonds (in some circumstances corporate bonds may be preferred)
- 10 years (convention within the DCF diet)
- Medium yield (zero coupon may be academically purer, but less frequently used).

For a mature market, the above are straightforward.

For less mature markets, there are two key issues:

1. Deriving a risk-free rate when no 10 year government bond exists
2. Determining whether the risk-free rate (actual or synthetically derived) includes all or part of the political risk premium.

Deriving a risk-free rate

If the country has some government bonds, but no 10 year bond, an artificial yield curve can be created by regressing the available bond data for the country against the mature market data.

If the country has no sovereign bond then a synthetic risk-free rate can be calculated. The approach is:

- Establish a country rating
  - e.g. Standard and Poor's AA
- Convert the ratings into percentage rates
  - e.g. 10.5%
- Regress the percentage risk-free rates to compare against a mature market
- Build a predictive model.

Local risk-free rate and the political risk premium

1. If it is considered that the local risk-free rate (actual or synthetically derived) entirely captures the country political risk premium then no further additions should be made to the WACC calculation. The Ke based on CAPM will be calculated using the local market risk-free rate
2. If the conclusion is that the local risk-free rate does not accurately capture the political risk, then the political risk premium must be incorporated elsewhere in the CAPM.
   If the political risk premium is included elsewhere in the CAPM then the risk-free rate should be based on the mature market and not on the local (overseas) risk-free rate.

Beta (β)

The beta selected and the equity market premium need to be consistent. There are many options. The most frequently analysed are:

1. Local beta measured against the local market index
2. Global beta measured against the global market index
3. Mature beta measured against the mature market index.

Most academics agree that a local beta measured against a local market is fairly meaningless.

There is more disagreement concerning a global beta measured against a global index, but the consensus appears to be in favour of using the mature beta measured against the mature market index.

The arguments follow from the statistical data availability in terms of numbers of observations and lack of distorting data.

The beta would be a bottom up beta, based on the industry average levered for the specific asset debt to equity ratio.

Care must be taken to ensure consistency of debt to equity ratios and of tax rates when degearing and regearing the beta.

Historic weekly betas with 2 or 3 year history (depending on changes in the nature or structure of the business) are generally preferred.

Given the averaging process a raw beta may be preferred to the adjusted.

Equity market premium

Using a mature market premium the usual questions arise in terms of measurement.

1. Premium over bonds or bills
2. Historic or forecast premia
3. Number of years of measurement (historic)
4. Geometric or arithmetic averages (historic).

There is no consensus here, but the premium is generally best calculated as far back as possible, over bonds. The statistical arguments with regard to geometric or arithmetic averages are complex and are far from trivial – assuming some form of correlation between periods, the geometric average is generally favoured.

Cross checking the result to the implied equity return backed out of current market values is a valid reference point.

The political risk premium / country risk premium

The political or country risk premium reflects the additional risk faced by investing in the overseas country – it aims to reflect the non-systematic risk associated with expropriation, currency blocks and capital market closures (it does not incorporate inflation which is incorporated into cash flows).

The argument advanced by Damodaran is that "the default spreads that come with country ratings provide an important first step, but still only measure the premium for default risk". Intuitively the country equity risk premium would be expected to be larger than the country default spread. To address the issue of how much higher, it is appropriate to look at the volatility of the country bond used to estimate the spread. This provides the following estimate for the country equity risk premium:

$$\text{Country equity risk premium} = \text{Country default spread} \times \frac{\sigma \text{ equity}}{\sigma \text{ country bond}}$$

This method has a good intuitive logic and will generally lead to a higher political risk premium than the more conventional uplift of the sovereign bond rate.

If this approach is used there are a number of options as to the restatement of the CAPM:

1. Ke = Rf (mature) + β (mature, bottom up) x (EMP mature) + PRP
2. Ke = Rf (mature) + β (mature, bottom up) x (EMP mature + PRP)
   Assuming the company exposure to country risk is proportional to its exposure to market risk
3. Ke = Rf (mature) + β (mature, bottom up) x (EMP mature) + λ (PRP).

Assuming the company exposure to be a product of factors other than those influencing market risk.

Many other approaches are possible, for example the Financial Strategy Group (FSG) at Citigroup published a paper (May 2002), in which a key conclusion included the recommendation of the following model:

$$\text{Ke} = \text{Rf (mature)} + \beta \text{ (global, bottom up)} \times \text{(EMP global)} + \frac{\lambda 1 + \lambda 2 + \lambda 3}{30} \times \text{(PRP)}$$

λ1 = access to capital markets (score 0 to 10)
λ2 = susceptibility of investment to political risk (score 0 to 10)
λ3 = importance of the investment to the investor (score 0 to 10)

This method will generally lead to a lower political risk premium than with the uplift of the sovereign bond rate.

Kd

The cost of debt should be calculated in a consistent fashion.

A workable version being:

Kd = Rf (inclusive of PRP) + credit risk premium x (1 – T) based on country tax rate

Weighting of Ke and Kd

The options available are as usual:

1. Industry average capital structure
2. Optimal capital structure
3. Current capital structure
4. Long term target capital structure.

Again, to maintain consistency it is important to reflect the leverage used when adjusting the beta factor.

Cash flows and exchange rates

The cost of capital logic detailed above assumes that the cash flows are forecast in nominal terms year by year in local currency.

These cash flows are then translated year by year using forecast exchange rates.

They are then discounted and the PV calculated.

An alternative approach is to discount the cash flows in the overseas currency.

In this instance it would be appropriate to increase the cost of capital to reflect the long-term inflation rate. For example:

$$Ke = \begin{array}{l} Rf\ (mature) + \beta\ (mature,\ bottom\ up) \times (EMP\ mature) \\ \quad + \lambda\ (PRP) + inflation\ differential \end{array}$$

The inflation differential could be backed out of the different yields on 10 year government bonds, so using the local bond rate may be a sensible proxy here.

7 • Rothschild standard models

Introduction

There are 18 standard models in total. These consist of:

- Three DCF models
- Two merger models
- Two comps models
- An LBO model
- A precedent transactions model
- Multiple models.

The models can be found on the L:\ drive (in the CTG standard models folder) for UK investment bankers and emailed upon request to other offices.

The comparable and precedent transaction models can be used to keep a running database for companies within sectors whereas all the others can be used as pitch models, with different outputs.

Discounted cash flow models

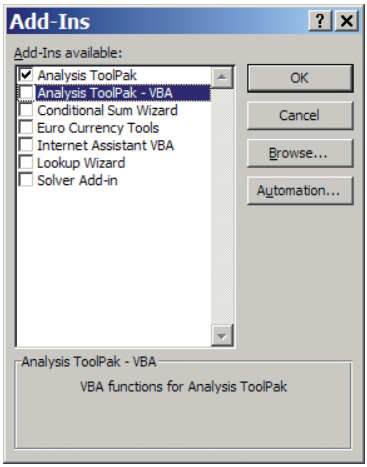
There are three DCF models, with different levels of complexity. The notes will concentrate on DCF II as this is the most useful model for illustration purposes. A comparison of the three models is given below.

Excel set-up

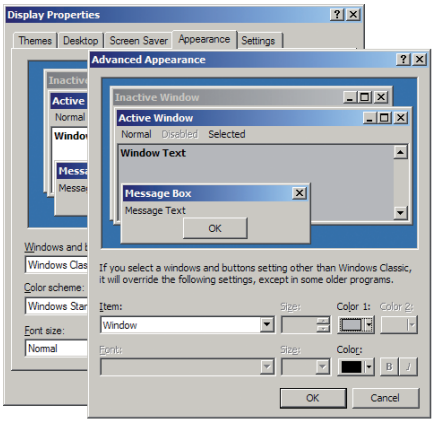
Before using any of the standard models ensure that the following is done:

Using the Tools / Add-Ins menu, ensure that "Analysis ToolPak" and "Report Manager" are both selected.

(Go into tools menu then add ins- tick analysis toolpak)

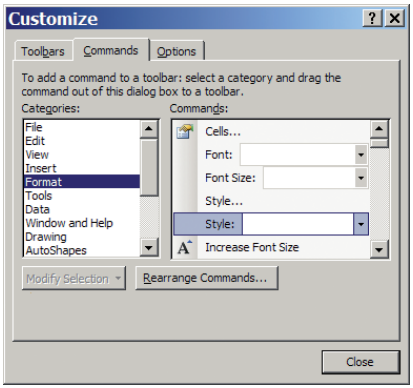


As there are significant areas of conditional formatting using white text within all the models, a pale grey background should be used so that the white text can be seen. To do this right mouse on the desktop; Go to Properties; then Appearance; then (Advanced Appearance); then Item: choose Window and change Color (sic) one to pale grey.



Back in Excel, the style drop down box should be added to your tool bar.

- Tools; then Customise; ensure customise is selected
- Drag the drop down box on to the toolbar.



This drop down box can then be accessed by using Alt ‘.

(For screen tools menu, then customise, select format and style)

Side by side analysis of the 3 DCF models

	DCF I	DCF II	DCF III
Minimum estimated completion time	30 mins	60 mins	90 mins+
1 statement model (CFS)	✔	✔	✘
Mid vs. end of year discounting flexibility	✔	✔	✔
Exit multiple scenario management	✔	✔	✔
Full sensitivity analysis	✔	✔	✔
Time flexible DCF 1st stage forecasting	✔	✔	✔
Detailed WACC calculation	✘	✔	✔
Comparable beta funtionality	✘	✔	✔
Broker input	✘	✔	✔
Segmental sales flexibility	✘	✔	✔
Capex flexibility	✘	✔	✔
Full operating scenario management	✘	✘	✔
3 statement integrated model	✘	✘	✔

DCF II Overview

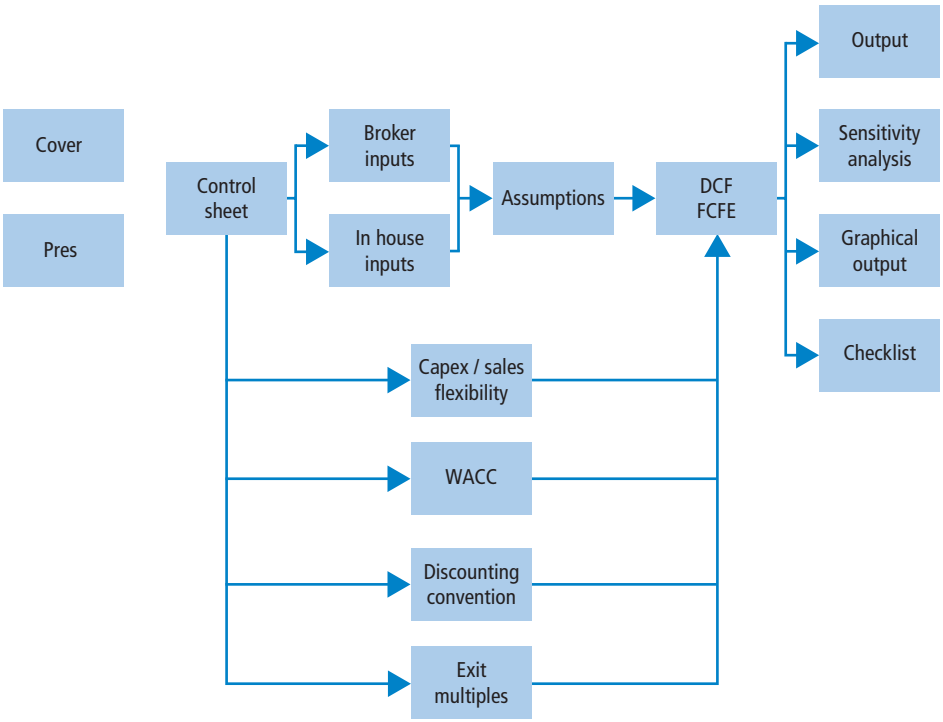
DCF II is a traditional discounted free cash flow to enterprise (FCFE) model. The cash flows are discounted using a weighted average cost of capital (WACC) which can be calculated using either service or comparable (relevered) betas.

The model does not produce a set of integrated financial statements. If this is required DCF III should be used.

The model does not explicitly deal with the treatment of tax losses. Therefore the effective tax rate as % of EBITA should be adjusted in the assumptions.

The output of the model is an initial valuation of either a listed company covered by brokers, or a private company requiring Rothschild in-house forecasts.

Model structure



The model is modular in its structure. This allows for a straightforward flow of information through the model, as well as allowing the model to be treated as a template whereby additional modules can be added.

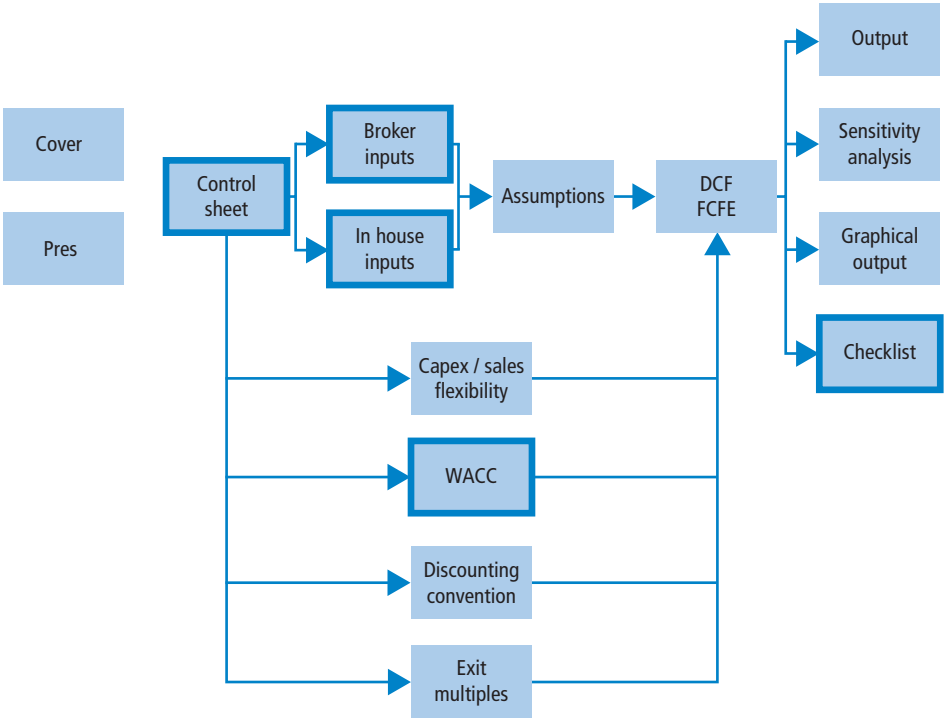
How to complete the model

DCF II should take about 1 hour to setup and run an initial valuation. The sources required can be found in:

- Annual and interim reports
- Brokers research notes
- Bloomberg beta information
- The comps model used to estimate an appropriate exit multiple and link in key input information.

The model requires input information in the following sheets:

- Control (In)
- Broker (In)
- In-house (In)
- WACC (In)
- Check (In).



All sheet tabs that require user defined inputs have the suffix (In) included in the sheet tab name.

The control sheet (In)

A sensible starting point for DCF II is the control sheet. This sheet holds inputs for:

- **Transaction year end and completion dates**

This information will be used to calculate; the discount factors; how many days' worth of the first forecast period to include using the transaction completion date as to.

- **Most recent balance sheet information for minority interest, net debt and joint ventures and associates**

This information will be used to calculate the breakdown of the implied enterprise value output from the DCF down to the implied equity value. This information should come from the most recent set of published information – annual, interim or preliminary reports.

Tesco company information		
Company name		Tesco
Project code		Glasgow
Transaction year end		24-Feb-08
Base currency		£
Base currency denomination		m
		£m
Base currency (per share)		p
Transaction completion date		31-Jan-08
Days remaining in base year (to 24 Feb 2008)		24 days
Most recent number of shares outstanding		6,932,225,203
Number of Tesco shares in issue	m	6,932.2
Date of most recent balance sheet information		11-Aug-07
Net debt / (cash)	£m	3,033
Minority interests	£m	36
Joint ventures/associates	£m	340

Source: Extract from DCF II (Control sheet)

The minority interest value is normally taken as the book value per the balance sheet. This is used as an estimate of the present value of the future cash flows from the minority.

Users can estimate the market value of minorities separately if desired.

The joint venture / associate is normally taken as the book value per the balance sheet – this is used as an estimate of the present value of the future cash flows from the joint ventures and associates.

Again market values can be calculated at the user's discretion.

Joint ventures – proportional consolidation

Joint ventures can be accounted for either using equity accounting or proportional consolidation under IFRS. If the joint ventures are equity accounted, the implied equity value associated with the JVs will be excluded from the FCFE enterprise value, and so will need to be included in the breakdown to equity value as part of the final valuation output.

Whilst equity accounting for joint ventures is a common method of consolidation in Europe (compulsory under US GAAP), the IFRS preferred method of JV consolidation is via proportional consolidation. This method will bring into the group accounts their contribution of the JV line by line into the financial statements. Therefore, all the metrics used to run a FCFE DCF will include the contribution from the JVs and as a result the value of the JVs will be included in the implied enterprise value.

If the JVs are proportionally consolidated DO NOT include a JV value in the control sheet.

The most recent number of shares outstanding is used to calculate the implied equity value per share. Sources for this information could be FACTSET, Thomson One, Extel cards or Bloomberg. Whilst these sources are highly accessible, they are not always current.

The alternative to these sources is to complete a roll forward. A roll forward involves taking the number of shares outstanding per the latest set of audited accounts and rolling this forward using stock exchange announcements for any equity issues or buybacks up to the transaction date.

- **Terminal value multiples and perpetuity growth rates** (base, downside and upside cases). The model allows up to twelve terminal value drivers. However, only one driver is required to run the model, as long as the appropriate switch has been chosen.

Terminal value drivers

	Upside	Base	Downside
Assumed terminal EBIT multiple	12.0x	7.5x	6.5x
Assumed terminal EBITA multiple	11.0x	7.5x	5.0x
Assumed terminal EBITDA multiple	10.0x	6.8x	5.0x
Assumed perpetuity growth rate	3.00%	2.00%	1.00%

Model management area

Terminal value scenario manager

Upside case exit
Base case exit
Downside case exit
Base case terminal value scenario applied

Exit multiple manager

EBIT multiple switch is ON - PRESS F9
EBITA multiple switch is off
EBITDA multiple switch is off
Growth perpetuity switch is off
Terminal value calculation is based on a EBIT multiple

Source: Extract from DCF II (Control sheet)

- **Basic WACC inputs** (risk-free rates, risk premiums, target capital structures etc.). The WACC calculation itself is completed on the WACC sheet. The control sheet allows the user to choose one of four different methods of applying beta to the cost of equity calculation.

WACC information

Risk free rate (10yr govt gilt)	4.50%
Equity market return	10.00%
Equity market risk premium	5.50%
Published beta	0.98
Tesco corporate borrowing margin (%)	0.75%
Tesco target Net Debt/Equity Value proportion	35.00%
Tesco corporation tax rate	30.00%
WACC	8.28%

Published beta - standard MV WACC
Comparable beta - MV WACC with tax
Comparable beta - MV WACC with no tax
Comparable beta - M&M WACC with tax

Published beta input used in standard MV WACC calculation

Source: Extract from DCF II (Control sheet)
Note: See page 196 and following for details

Target capital structure consistency – WACC and Betas

DCF II ensures that the same target capital structure is used to weight the WACC and to relever comparable betas (when appropriate). The model will automatically convert the target D/E input into a target D/D+E proportion for WACC weighting purposes.

$$\beta L = \left[1 + \left(\frac{D}{E_{Target}} \right) x (1 - T) \right]$$

$$WACC = Ke \times \left(1 - \frac{D}{D + E_{Target}}\right) + Kd \times \frac{D}{D + E_{Target}}$$

The broker and in-house sheets (In)

The broker sheet is used to input historical operating data and broker forecasts. The number of years of broker information to be used in the forecasts for the DCF will be defined in the broker information area on the control page (see extract below). The model will ensure that the broker and in-house information are amalgamated in the main free cash flow to enterprise forecasts contained within the DCF.

Broker information	
Broker name	Merrill Lynch
Date of report	27-Nov-08
Last broker forecast year end to be applied to DCF	24-Feb-10
Maximum number of forecast years available	3 years
Number of forecast years to be used	3 years

Source: Extract from DCF II (Control sheet)

The in-house sheet requires the user to define the necessary free cash flow assumptions in order to drive the DCF model. The key issues here are to make sure that the assumptions are consistent with the business model and the market. The graph sheet is a useful area to review the consistency of these assumptions.

The WACC sheet (In)

The WACC sheet requires inputs if the user wishes to use comparable betas to drive the beta calculation. Otherwise the WACC calculation is driven off the basic WACC information contained on the control sheet.

The check sheet (In)

The check sheet is a sense checklist that ensures that all key inputs and considerations have been addressed before the model is reviewed.

Key elements and functionality of model

DCF II is a traditional two stage DCF FCFE model, discounting the cash flow forecasts with a WACC.

The terminal value can be calculated using either a FCFE cash flow perpetuity or an enterprise value exit multiple.

The WACC is a weighted average cost of capital using cost of equity and debt weighted by a target net debt / net debt and equity proportion. The cost of equity can be calculated using a traditional service beta (Bloomberg or LBS for instance) or through deleveraging and releveraging comparable betas.

Key functionality within the model:

- Time flexible DCF FCFE 1st stage forecasting (between 1 year and 10 year forecasting periods)
- Broker / in-house integrated inputs (number of broker years flexibility)
- Segmental sales flexibility
- Capex driver flexibility
- Detailed WACC
- Four methods for beta deleveraging
- Mid year valuation and discounting
- Terminal value discounting with mid-year discounting.

Time flexible DCF FCFE 1st stage forecasting

The model allows the user to run a time flexible 1st stage forecasting period. The model is set up for a 10 year forecast period, although inserting additional columns and copying formulae across will allow the forecasting period to be extended beyond this maximum.

Date of last share price quotation		30-Jan-08
Average share price	p	236.00
Average share price	p	240.00
Length of DCF period (years)		10 years
Terminal year		Feb 2017
Is the mid-year discounting to be applied?	☑	
Is the cash flow perpetuity calculated using the mid-year discounting convention?	☑	

Source: Extract from DCF II (Control sheet)

By entering less than 10 years into the length of DCF period (years) cell, the model will conditionally format the DCF output sheet to show the appropriate number of forecast years in arriving at the implied enterprise value.

Care must be taken when running a short period (<10 years) DCF to ensure that the forecasting assumptions run consistently into the terminal value calculation.

Broker / In-house integrated inputs

The model allows the easy integration of broker and in-house forecasts. The model does not deal with multiple brokers or the creation of consensus estimates as in the comps model. However a single set of broker estimates can be combined with in-house estimates. These can be linked to the comps model.

The broker integration is found on the control sheet:

Broker information	
Broker name	Merrill Lynch
Date of report	27-Nov-08
Last broker forecast year end to be applied to DCF	24-Feb-10
Maximum number of forecast years available	3 years
Number of forecast years to be used	3 years

Source: Extract from DCF II (Control sheet)

The broker name and report date information is purely memorandum information and is not used actively in the model.

The last broker forecast year-end to be applied to the DCF is used to work out how many years of broker forecast data could be used in the forecasts. The model calculates the maximum number of forecast years available for the forecast period. It is then left to the user to define how many of

the broker forecast periods will be used in the forecast. The model will not allow the number of forecast years to be used to be greater than the maximum number of forecast years available.

The impact of this choice is to:

- Conditionally format the broker sheet. For example if the user has defined that 3 years of the broker forecasts will be used in the model. This user defined choice will then format the broker sheet to demand inputs for 3 years of historical data together with 3 years of broker inputs. Financial information beyond the third year of forecasts will be produced using in-house forecasts from the in-house input sheet.

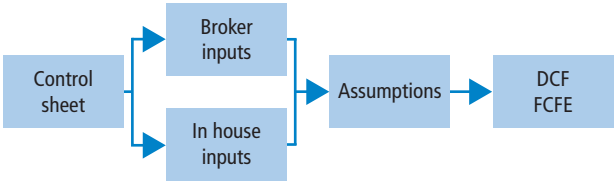
Broker's forecasts for Tesco

Terminal year is 2017

Sales are forecast on segmental basis

	Actuals			Broker		
Year ending in February	2005	2006	2007	2008	2009	2010
Profit & loss drivers				1	2	3
Sales	17,158	18,796	20,988	23,653	26,766	30,367
UK	15,835	16,958	18,372	20,052	22,320	25,677
Rest of Europe	1,167	1,374	1,756	2,203	2,222	2,455
Asia	156	464	860	1,398	2,224	2,235
sales 4	-	-	-	-	-	-
sales 5	-	-	-	-	-	-
sales 6	-	-	-	-	-	-
Sales check	OK	OK	OK	OK	OK	OK
EBIT	1,000	1,030	1,166	1,322	1,571	1,801
EBIT margin	5.8%	5.5%	5.6%	5.6%	5.9%	5.9%
Amortisation	5	7	8	10	10	10
EBITA	1,005	1,037	1,174	1,332	1,581	1,811
Depreciation	401	428	468	524	570	579
EBITDA	1,406	1,465	1,642	1,856	2,151	2,390

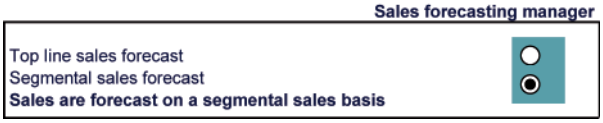
Source: Extract from DCF II (Broker sheet)



The broker and in-house forecasts and assumptions will be amalgamated into cash flow drivers on the assumptions sheet.

Segmental sales flexibility

The model allows the user to run operating forecasts for sales at a segmental level (geographical or separate business unit segmentation).



Source: Extract from DCF II (Control sheet)

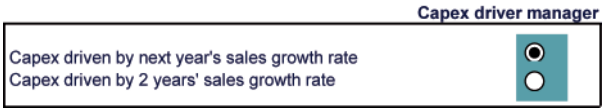
This functionality is controlled via an option button on the control sheet, together with the financial inputs on the broker sheet and the forecast drivers on the in-house sheet.

If the user selects that the sales forecasting manager should use segmental sales forecasting (as in the above extract), the model will use the segmental sales driver information (which will need inputting on the broker and in-house sheet).

This level of functionality is especially useful for business models with well defined business units or geographical business areas. The quality of historical information contained within the annual report and the brokers' research may provide a practical constraint of this functionality.

Capex driver flexibility

The capex is driven as a percentage of a sales growth rate. The model offers the flexibility of driving the capex on next year's sales growth rate or on a sales growth rate in 2 year's time. The reason for this flexibility is to allow the user to think about the business model of the target company and the lead time between capex investment and impact on sales.



Source: Extract from DCF II (Control sheet)

Detailed WACC

The WACC is calculated using CAPM for the cost of equity and a standard credit risk spread over a benchmark risk-free rate for the cost of debt, weighted by a target net debt / equity rate. (The model converts this ratio

into a net debt / net debt and equity ratio for the purposes of weighting the WACC).

WACC information	
Risk free rate (10yr govt gilt)	4.50%
Equity market return	10.00%
Equity market risk premium	5.50%
Published beta	0.98
Tesco corporate borrowing margin (%)	0.75%
Tesco target Net Debt/Equity Value proportion	35.00%
Tesco corporation tax rate	30.00%
WACC	8.28%

Published beta - standard MV WACC
Comparable beta - MV WACC with tax
Comparable beta - MV WACC with no tax
Comparable beta - M&M WACC with tax

Published beta input used in standard MV WACC calculation

Source: Extract from DCF II (Control sheet)

The standard WACC inputs are included on the control sheet. If the model has checked the listed company switch, the WACC inputs will ask for a published beta (Bloomberg, LBS etc.).

Is Tesco a listed company? ☑

Source: Extract from DCF II (Control sheet)

It is worth putting a comment in the model, stating what the parameters of the service beta calculation are. For example, a 3 year weekly beta regressed against Morgan Stanley Global Composite.

If published beta information is not available or is unreliable, the model offers a choice of three comparable beta calculations:

- Comparable beta using MV WACC with tax
- Comparable beta using MV WACC with no tax or
- Comparable beta using M&M with tax.

The calculation of WACC is completed on the WACC calculation sheet.

The WACC sheet can be separated into a five sections:

- Cost of capital calculation summary (see extract below)
- Cost of equity calculation summary
- Market value target gearing weighting
- Modigliani-Miller calculation
- Beta deleveraging and releveraging.

The summary WACC calculation is the presentational output for the WACC sheet. It summarises the detailed beta, cost of equity and debt calculations found further down the sheet.

Cost of capital calculation for Tesco

Beta		Cost of debt	
Published beta - standard MV WACC	0.98	Risk free rate	4.50%
		Corporate borrowing margin over risk free rate	0.75%
		Corporate borrowing rate	5.25%
		Tesco corporation tax rate	30.0%
		Post-tax cost of debt	3.68%

Cost of equity		WACC	
Risk free rate (10yr govt gilt)	4.50%	Cost of equity	9.89%
Published beta	0.98	Post-tax cost of debt	3.68%
Equity market risk premium	5.50%	Tesco target Net Debt/Equity Value proportion	35.0%
		Tesco target net debt/Enterprise Value proportion	25.9%
Cost of equity	9.89%	**WACC calculated using market value weighting**	8.28%

* Published beta - standard MV WACC

Published beta - standard MV WACC
Comparable beta - MV WACC with tax
Comparable beta - MV WACC with no tax
Comparable beta - M&M WACC with tax

Published beta input used in standard MV WACC calculation

Source: Extract from DCF II (WACC sheet)

The switch below the WACC summary runs the beta calculation functionality and is driven from the control sheet.

The cost of debt is a standard credit risk spread over a benchmark risk-free rate, taken net of the interest tax shield. There are no beta of debt calculations included in the model.

Beta deleveraging

The user has the ability to define one of four methods of applying the beta to the WACC calculation.

- Published beta (Bloomberg, LBS etc.)
- Comparable beta using MV WACC with tax
- Comparable beta using MV WACC with no tax or
- Comparable beta using M&M with tax.

Service betas from different sources may not agree with one another due to the choices made for the following key variables:

- Time period over which measurements are made
- Frequency of measurements within the chosen time period

- Risk-free rate
- Market index (remember to use a global index).

Betas are affected by a company's gearing (leverage). The risk to equity investors in a geared company is higher than in an ungeared company because the costs of debt financing must be met before a return can be made for equity investors. This financial risk is part of systematic risk and is reflected in a company's beta.

A service beta will reflect the capital structure of the company during the measurement period. This beta should be adjusted if it is to be used in the DCF models when the target capital structure is deemed to be materially different from the historical capital structure. This can have a significant impact on the cost of equity because the beta is multiplied by the equity risk premium in the CAPM cost of equity calculation.

DCF II does not automatically relever the service beta to reflect the target capital structure of the target company. If necessary this must be done manually by the user.

Comparable beta calculations

DCF II allows the user to use comparable betas in order to calculate the cost of equity. This is useful when service betas are unavailable or deemed to be unreliable.

Most betas fall within the range of 0.6 to 1.5. If a company's beta falls outside this range, then its returns will appear to be extremely sensitive (high beta) or insensitive (low beta) to factors that affect the returns of the market as a whole over the measurement period. The conditions that are causing this are unlikely to persist. Therefore, users should consider whether it is appropriate to use the published beta.

The alternative to service betas is to use comparable company betas. These betas will reflect the capital structures of the companies included in the sample over their measurement periods. The financial risk embodied in these betas is likely to be different to the target company. Therefore the comparable betas should be delevered, removing the impact of the financial risk over the measurement period and then relevered to reflect the target capital structure.

There are a number of methods that can be used to delever and relever betas. As there is limited consensus as to what is the most appropriate way to delever and relever the beta, DCF II includes three of the more common methods:

- Comparable beta used to derive MV WACC with tax. This is commonly used by investment banks and is supported by academics
- Comparable beta used to derive MV WACC with no tax. This is advocated by some academics and relies on the underlying assumption of interest tax shields discounted using an unlevered cost of equity
- Comparable beta used to derive M&M WACC. This is rarely used in practice and assumes the interest tax shield is discounted at the cost of debt.

All three methods are completed on the WACC sheet. The comparable beta sample information must be inputted. The inputs required are:

- Comparable betas (these will be levered)
- Current comparable gearing (D/E)
- Marginal tax rates.

Beta calculation

Comparable beta universe

With tax deleveraging	Leveraged comparable betas (β_L)	Current comparable gearing (D/E)	Marginal tax rates	Deleverage with tax formula (β_U)	Leverage with tax formula (β_L)
Comparable beta 1	0.95	42.0%	30.0%	0.73	0.91
Comparable beta 2	0.85	42.0%	30.0%	0.66	0.82
Comparable beta 3	0.92	50.0%	30.0%	0.68	0.85
Comparable beta 4	1.02	52.0%	30.0%	0.75	0.93
Comparable beta 5	1.06	54.0%	30.0%	0.77	0.96
Comparable beta 6	0.93	46.0%	30.0%	0.70	0.88
Comparable beta 7	1.12	48.0%	30.0%	0.84	1.04
Comparable beta 8	1.02	52.0%	30.0%	0.75	0.93
Comparable beta 9	1.15	51.0%	30.0%	0.85	1.06
Comparable beta 10	0.90	49.0%	30.0%	0.67	0.83
Average				0.74	0.92
High				0.85	1.06
Low				0.66	0.82

Source: Extract from DCF II (WACC sheet)

The "with tax" deleveraging method will delever the comparable betas using the following equation:

Delevering formula (with tax)

$$\beta u = \frac{\beta L}{\left[1 + \left(\frac{D}{E}_{Comparable}\right) x (1 - T)\right]}$$

The above equation delevers with the **current** capital structure and marginal tax rate of the comparable company.

The "with tax" method then relevers the delevered comparable beta with the **target** capital structure of the **target** company using the equation below:

$$\beta L = \left[1 + \left(\frac{D}{E}_{Target}\right) x\ (1 - T)\right]$$

DCF II will then calculate the average relevered "with tax" beta. This beta is then used to calculate the cost of equity.

DCF II will use the average relevered "with tax" beta. Review the beta sample for outliers before relying on an average beta. The user does not have to use the arithmetic average when calculating the cost of equity. The model can be altered, at user discretion, to use a weighted average comparable beta if necessary. **Document all changes to the model using a comment.**

The "without tax" method is essentially the same calculation using the above de and relevering equations, with the tax shield stripped out of the equations:

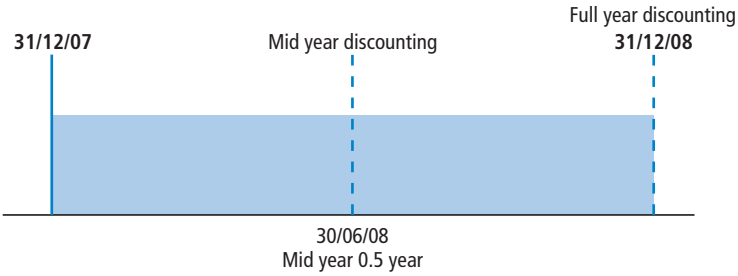
$$\beta u = \frac{\beta L}{\left[1 + \left(\frac{D}{E}_{Comparable}\right)\right]}$$

$$\beta L = \left[1 + \left(\frac{D}{E}_{Target}\right)\right]$$

The comparable beta approach used to derive M&M WACC utilises the "with tax" deleveraged beta to calculate the unlevered cost of equity.

Mid year discounting

Most standard DCF models assume that the cash flows occur at the end of each forecast period. Given that a business' cash flow will be generated throughout a period, this assumption does not reflect the true behaviour of the cash flow generation.



Full year discounting would involve discounting the cash flows using the standard discounting equation:

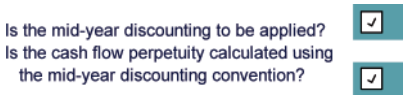
$$= \frac{1}{(1 + \text{WACC})^{N}}$$

Mid year discounting would discount the 1st period cash flows using the amended mid year equation:

$$= \frac{1}{(1 + \text{WACC})^{0.5}}$$

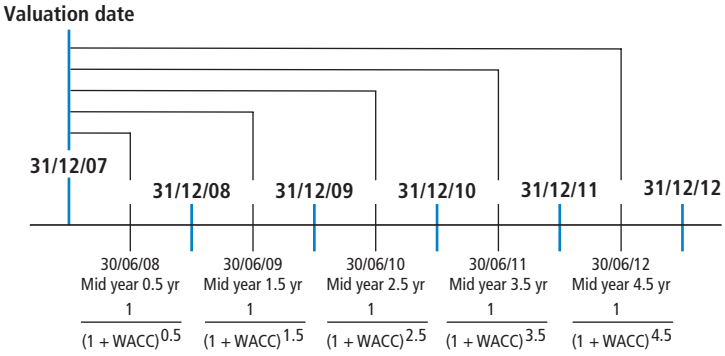
DCF II has the functionality to run the discounting using standard end of year discounting or with mid-year discounting. Mid-year discounting assumes that the cash flows occur in the middle of the period.

The discounting switch is on the control sheet.



Source: Extract from DCF II (Control sheet)

If the mid-year discounting switch is checked, the FCFE will be discounted assuming that the cash flows occur mid-year.



Mid year valuation

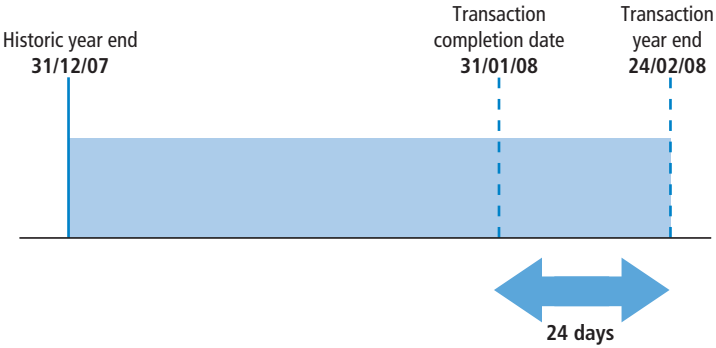
DCF II allows the user to perform a mid year valuation of the target company. Using the extract below as the example – the transaction completion date is the valuation date that the entire model will be benchmarked and discounted to.

The **transaction year end** is the current year end of the target company and must be after the transaction completion date.

Tesco company information	
Company name	Tesco
Project code	Glasgow
Transaction year end	24-Feb-08
Base currency	£
Base currency denomination	m
	£m
Base currency (per share)	p
Transaction completion date	31-Jan-08
Days remaining in base year (to 24 Feb 2008)	24 days

Source: Extract from DCF II (Control sheet)

This information when entered into the model will be used to calculate the number of days between the valuation date and the 1st period year end (the transaction year end).



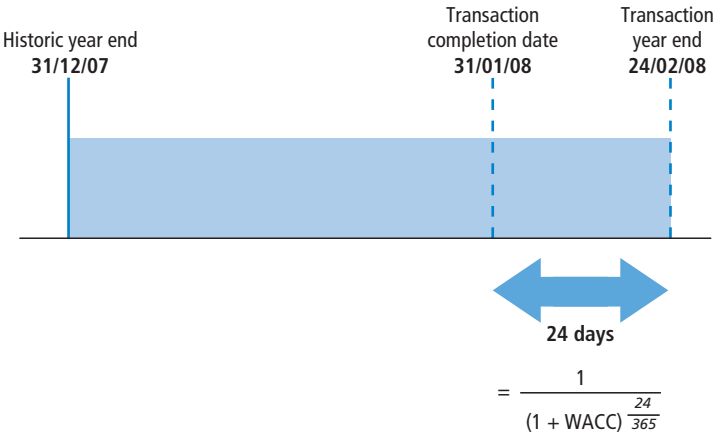
The model ensures that this first period is only discounted in line with the number of days using a partial period discounting equation:

1st period partial discounting:

$$= \frac{1}{(1 + \text{WACC})^{\frac{Days}{365}}}$$

Where:
Days = the number of days included in the 1st period discounting
= transaction year end – transaction completion date
= 24 February – 31 January
= 24 days

$$= \frac{1}{(1 + \text{WACC})^{\frac{24}{365}}}$$



The mid year discounting / mid year valuation equation would be:

$$= \frac{1}{(1 + WACC)^{\left[\frac{\frac{24}{2}}{365}\right]}}$$

Subsequent period discounting

The discounting equation for subsequent periods needs some very clear thought in order to be consistent with the mid year or end of year discounting conventions.

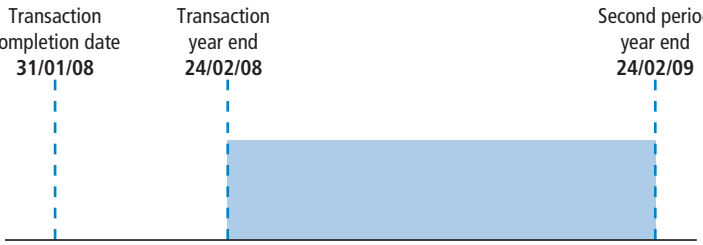
Subsequent period discounting (end of year discounting)

If end of year discounting is applied to the model the subsequent period discounting is relatively straight forward.

The standard year end discounting equation is adjusted to take into consideration the short first period discounting. In a standard full year / end of year discounting model the second year cash flow would be discounted using:

$$= \frac{1}{(1 + WACC)^{2}}$$

This equation assumes 2 x 365 days between the valuation date and the second period end. Following this illustration we have 24 days + 365 days (389 days) between the valuation date and the second period end. Hence using the standard equation above would over discount the cash flows.



$$DF_1 = \frac{1}{(1 + WACC)^{\frac{24}{365}}} \qquad DF_{N+1} = \frac{1}{(1 + WACC)} \quad \text{1 period (365 days) discount factor}$$

389 days

$$= \frac{DF_1}{(1 + WACC)}$$

$$= DF_1 \times DF_2$$

$$= \frac{1}{(1 + WACC)^{\frac{24}{365}}} + \frac{1}{(1 + WACC)}$$

$$= \frac{1}{(1 + WACC)^{\frac{24}{365}}} \times \frac{1}{(1 + WACC)^{\frac{365}{365}}}$$

Which can simplify to:

$$= \frac{1}{(1 + WACC)^{\frac{24 + 365}{365}}}$$

Where:
DF1 = 1st period discount factor
DF2 = 2nd period discount factor

The formulae used in DCF II for subsequent periods is $= \frac{DF_{\text{previous period}}}{(1 + WACC)}$

Subsequent period discounting (mid-year discounting)

Having spent some time explaining the subsequent year discounting for the end of year convention, the mid-year convention subsequent year end equation becomes almost self explanatory, as the raising to the power element of the equation:

$$\frac{24 + 365}{365}$$ becomes

$$\frac{24 + \frac{365}{2}}{365}$$ in order to reflect the mid discounting convention.

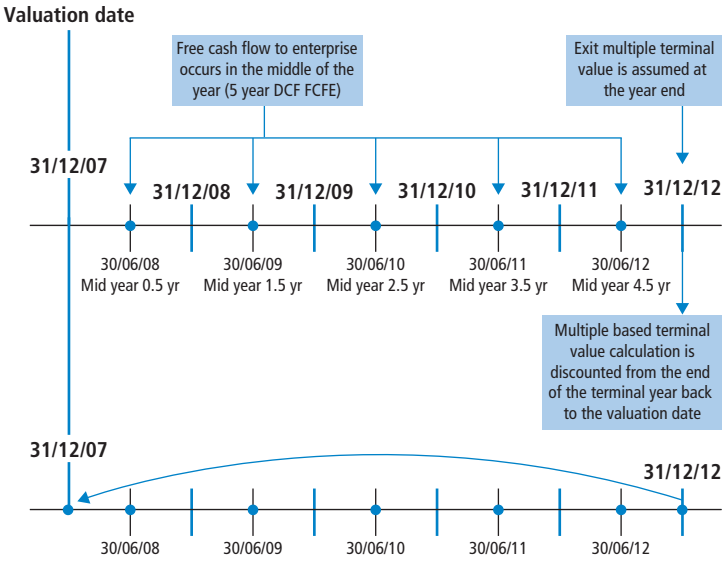
The full equation being: $$= \frac{1}{(1 + \text{WACC})\left[\frac{24 + \frac{365}{2}}{365}\right]}$$

Terminal value discounting with mid-year discounting

The use of mid year discounting creates technical issues surrounding the discounting of the terminal value.

Multiple exit with mid-year discounting

An exit multiple terminal value is assumed to be calculated at the end of the terminal year (see illustration below) and as such should be discounted back from this terminal year end position to the valuation date.



Mid year discounting – exit multiple terminal value

The terminal value using an exit multiple approach is discounted from the **end of the final period** back to the valuation date.

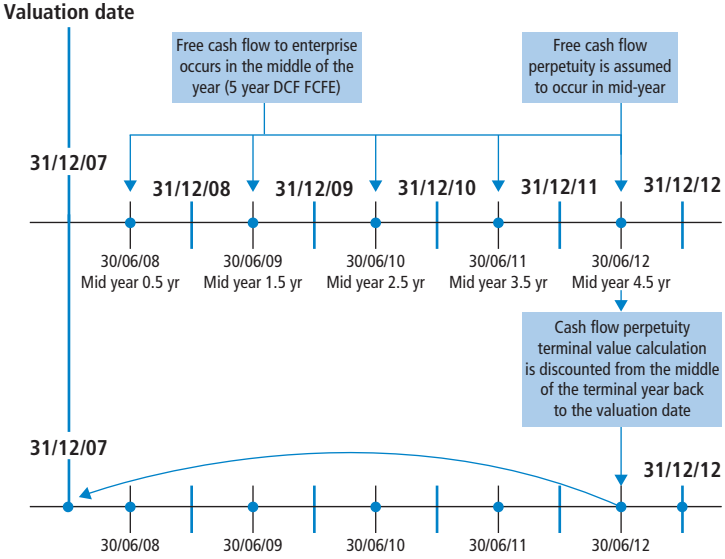
Cash flow perpetuity with mid-year discounting

A FCFE growth perpetuity terminal value should be calculated at the mid-point of the terminal forecast year (t10 in a 10 year, two stage DCF model) and should be discounted for the period between the valuation date and the mid-point of the final forecast year.

DCF II offers the user the option to treat the cash perpetuity terminal value as arising either in the middle of the terminal year or at the end of the terminal year. To be consistent between the timing of the terminal value calculation and the mid year discounting convention the option box in DCF II should be checked (as illustrated below).

Is the mid-year discounting to be applied?	☑
Is the cash flow perpetuity calculated using the mid-year discounting convention?	☑

Source: Extract from DCF II (Control sheet)



Mid year discounting –cash flow perpetuity terminal value

The terminal value using cash flow perpetuity approach is discounted from the **mid-point of the final period** back to the valuation date.

Review points

Assumption inconsistency (graphical review)

The graph sheet included in DCF II is useful for extracting graphs for inclusion within presentations and pitches. However, its key use is to initially sense check the consistency of assumptions included in the free cash flow forecasts.

Assumption inconsistency may be reflected in the graphs through unexplained peaks and troughs over the forecasting period. The profile of the graphs should be capable of full explanation by the user.

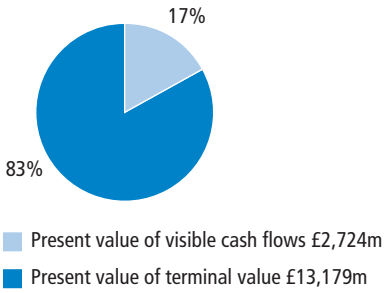
The graph sheet provides forecast cash flow driver graphical information for:

- Growth rates (sales, EBIT, EBITA, EBITDA and operating cash flow)
- Capex development
- Margin development
- Sales profiles.

70 / 30 split on EV

The 70 / 30 EV split is a rough sense check on the profile of the enterprise value. On a standard 10 year DCF model, for a mature business, a rough EV profile would see 70% of the EV coming from the present value of the terminal value, with the residual 30% being the present value of the visible 10 year cash flow period. This is not a hard and fast rule, but it does give rise to questions when the split becomes somewhat more disparate.

Tesco enterprise value breakdown



Source: Extract from DCF II (Graph sheet)

For instance, a high present value of the terminal value split may suggest issues such as:

- Perpetuity growth rates being too bullish
- Exit multiples being too bullish
- Terminal year metrics being too high or capturing too much growth
- The visible cash flow period (i.e. 5 year DCFs) being too short.

Inconsistency on the exit scenario

DCF II is able to run a number of different terminal value drivers. There is the ability to choose base, upside and downside cases for:

- EBIT exit multiples
- EBITA exit multiples
- EBITDA exit multiples and
- Growth perpetuities.

The management of these terminal value options is driven off the control sheet.

The key issue with the terminal value drivers is to make sure that the drivers are consistent with the visible period free cash flow assumptions. For instance a bearish set of free cash flow assumptions followed by an upside terminal value driver naturally delivers an inconsistent valuation.

Terminal value drivers

	Upside	Base	Downside
Assumed terminal EBIT multiple	12.0x	7.5x	6.5x
Assumed terminal EBITA multiple	11.0x	7.5x	5.0x
Assumed terminal EBITDA multiple	10.0x	6.8x	5.0x
Assumed perpetuity growth rate	3.00%	2.00%	1.00%

Model management area

Terminal value scenario manager

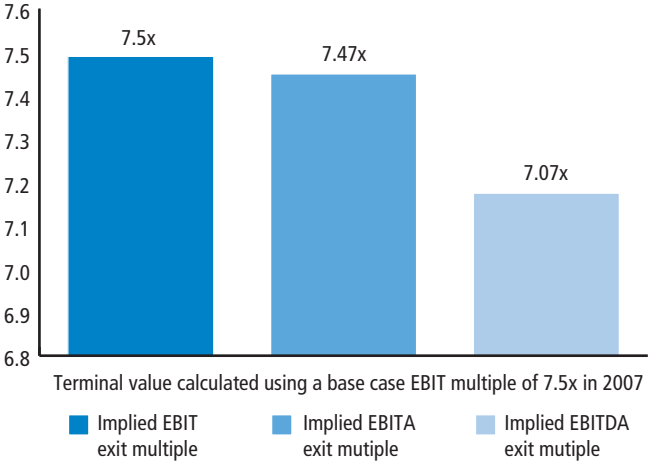
Upside case exit
Base case exit
Downside case exit
Base case terminal value scenario applied

Source: Extract from DCF II (Control sheet)

Implied exit multiples vs. peer group

DCF II will calculate the implied terminal value multiples for any given method of exit. This provides the user with the option of sense checking the multiples against different metrics as well as against peer group comparables.

Tesco implied exit multiples in the terminal value



Source: Extract from DCF II (Graph sheet)

Updating of data tables

Sensitivity ranges

	model input	table input	increment
EBIT exit multiple	7.5x	7.5x	0.5x
EBITA exit multiple	7.5x	7.5x	0.5x
EBITDA exit multiple	6.8x	6.8x	0.5x
Perpetuity growth rate	1.00%	1.00%	0.50%
WACC	8.28%	8.28%	0.25%
Market risk premium	5.50%	5.50%	0.50%
Tesco equity beta	0.98	0.98	0.05

Source: Extract from DCF II (Control sheet)

The table input multiple, number or percentage is the central value in the data table and it should be equal to the model input data. This can be done by copying the model input values in the first column to the table inputs column. The table inputs must not be linked into the model hence the values must be copied, not the formula. Once this has been done F9 should be pressed to update the tables. This will ensure that the construction of the

data tables will be consistent with the information used in the main body of the model.

The merger models

A detailed analysis and comparison of these models is given in the accounting and financial analysis manual.

This manual concentrates on how the models should be completed by the user.

Merger I

Overview

The model analyses a bidder acquiring a stake in a target giving it at least significant influence.

The model compares the bidder's EPS pre the transaction with its EPS post the transaction and assumes that new finance is raised to make the acquisition.

The key outputs of the model are:

- The EPS accretion / dilution of the bidder
- The proforma balance sheet after the acquisition and key proforma gearing ratios.

Any synergies that arise are assumed to arise within the bidder for tax and minority interest purposes.

The effect of dividends is not considered within this model.

The model has some functionality and flexibility. It can deal with:

- Different currencies of Target and Bidder – the model can also cope with £ and p versus € and € for example
- Different year ends of Target and Bidder – see below for help
- Quoted or private Target (which can be valued in five different ways)
- Using up to date balance sheet values for capital structure
- Incorporating (or not) Target's share options and long term incentive plans
- Acquisitions from 20%-100% (it can cope with equity accounting and acquisition accounting).

How to complete the model

The source information required to complete this model are:

- Annual and interim reports

- Brokers research notes
- Information to determine the most recent number of shares in issue
- Share prices
- Exchange rates.

There are three input sheets that need to be completed:

- Control (In)
- Options (In) (if applicable) – these can be linked into the relevant company data in the comps model
- Checklist (In).

The control input sheet

All inputs should be deleted from the input sheet.

The easiest way to complete this sheet in a fast and accurate manner is to link it to the comps model for that sector.

The last historic year ends of the bidder and target are input. If these are not coterminous then prorating of the target's results is required.

Bidder			Target
Name	ABC	*Bidder*	XYZ
Historic year end	23-Feb-08	*YEHistBidder*	30-Mar-08

Source: Merger1 Control (In) sheet

This prorating is on the EPS sheet.

Workings

					XYZ year end
XYZ pro-rating	**Mar-07**	**Mar-08**	**Mar-09**	**Mar-10**	**Mar-11**
	9.6%	90.2%	-	-	-
% profits in year ending Feb '09		9.6%	90.2%	-	-
% profits in year ending Feb '10		-	9.6%	90.2%	-
% profits in year ending Feb '11		-	-	9.6%	90.2%
% post acquisition profits in year ending Mar '09					
Completion (Jul '08) - XYZ y.e. (Mar '09)			66.3%		
Completion (Jul '08) - ABC y.e. (Feb '09)			56.7%		
% post acquisition profits					
in year ending Feb '09			56.7%	-	-
in year ending Feb '10			9.6%	90.2%	-
in year ending Feb '11			-	9.6%	90.2%
Forecasts					
EPS (pre goodwill)	$		0.23	0.26	0.29
Average shares	m		1,916.0	1,930.8	1,930.8
Net income (pre goodwill)	£m		4	5	6

Source: Merger1 EPS sheet

The base currency for the bidder and the target has to be input directly. No drop down list is available. If the base currency of the bidder and the target are the same then in row 29 a message will appear stating that the exchange rate must be 1.0.

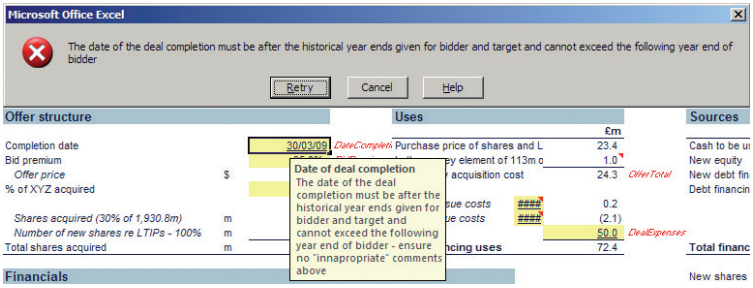
Bidder				Target		
Name		ABC	Bidder			XYZ
Historic year end		23-Feb-08	YEHistBidder			30-Mar-08
Base currency		£	CurrencyBidder			£
Base currency denomination		m	Denomination			
		£m	BaseCurrUnits			£m
Per share denomination		p	CurrencyPerShBidder			p
Most recent number of outstanding shares		7,998,465,789				1,930,800,000
	m	7,998.5	ShsOfStBidder		m	1,930.8
Balance sheet (forecast @ closing)						
Goodwill	£m	600			£m	400
Other assets	£m	34,567			£m	10,602
	£m	35,167			£m	11,002
Net debt	£m	4,560			£m	456
Minority interests	£m	45			£m	65
Equity	£m	4,467			£m	4,567
Other liabilities	£m	26,095			£m	5,914
Total liabilities & equity	£m	35,167			£m	11,002
Date of last share price quotation		30-Jun-08	QuoteBidder	XYZ is a listed company?		☑
Share price @ 30 Jun 2008	p	400.90	ShPriceBidder			30-Jun-08
Exchange rate (must be 1.00)		0.70	ExchRateBido	@ 30 Jun 2008	p	2.99
Debt interest rate		6.0%	IntRate			
Cash to be used in acquisition	£m	300	CashPayment			
Cash interest rate		3.5%	IntRateCash			

Source: Merger1 Control (In) sheet

The balance sheet of both the bidder and the target will always balance as any slack is taken by other liabilities. The final figure for other liabilities should be reviewed for reasonableness.

The balance sheet for the target should be input using fair values.

A suitable completion date must be input. The date of the deal completion must be after both the bidder's and target's historic year end and cannot exceed the following year end of the bidder. If an inappropriate completion date is input then an error message will appear.

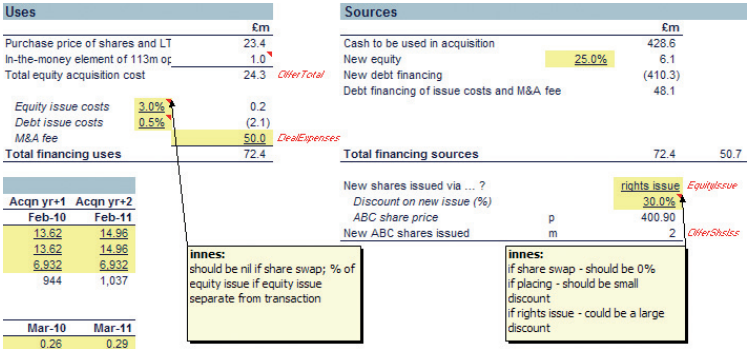


Source: Merger1 Control (In) sheet

For example if the year end of the bidder is 31/03/07 and the completion date is 31/07/08, the year end of the bidder would be inappropriate as by this time accounts for the year ending 31/03/08 would be available for the bidder.

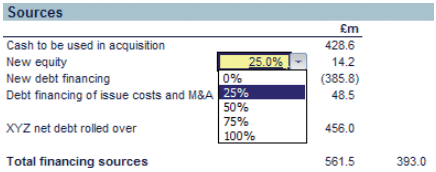
The reason for these constraints is the complexity regarding the pro rating of the year ends.

The funds can be sourced using own cash, equity and debt. The equity can be issued via a share swap, placing or rights issue. If a share swap is used, the equity issue costs will be nil as will the discount on the issue price of the new issue of shares.



Source: Merger1 Control (In) sheet

There is a drop down box for selecting the proportion of equity funding to use in the transaction. 0% through to 100%, in 25% intervals, can be selected.



Synergies for the next forecast 3 years can be entered. These are assumed to arise within the bidder.

As goodwill is no longer amortised the input for the useful economic life is no longer applicable, so enter n/a. Therefore there will be no tax deductibility.

Fair value adjustments are now available in Merger II model as discussed later.

The EPS numbers for the financials are taken from the broker's forecasts. The EPS figures pre and post goodwill should be the same assuming there is no longer any goodwill amortisation. The name of the broker and date of the brokers forecasts are given for memorandum purposes. The EPS and no of shares are used to calculate a net income figure. These net income figures

should be checked for reasonableness to ensure that they are in line with brokers forecasts.

Financials

ABC		Historic Feb-08	Acqn yr Feb-09	Acqn yr+1 Feb-10	Acqn yr+2 Feb-11
EPS (post goodwill)	p	11.53	12.22	13.62	14.96
EPS (pre goodwill)	p	11.53	12.22	13.62	14.96
Average shares	m	6,792	6,862	6,932	6,932
net income (pre goodwill)	£m	783	839	944	1,037
source			SSSB		
date			26-Mar-08		
XYZ		**Mar-08**	**Mar-09**	**Mar-10**	**Mar-11**
EPS (pre goodwill)		0.19	0.23	0.26	0.29
Average shares	m	1,902	1,916	1,931	1,931
net income (pre goodwill)	£m	4	4	5	6
source			DKW		

Ensure that this is in line with the broker where applicable - alter inputs as necessary

Source: Merger1 Control (In) sheet

EPS sheet

The EPS sheet calculates the following for the historic and forecast 3 years:

- EPS accretion / (dilution) pre any goodwill adjustments
- Synergies required for nil dilution pre any goodwill adjustments
- EPS accretion / (dilution) post any goodwill adjustments
- Synergies required for nil dilution post any goodwill adjustments.

The synergies required for nil dilution could also be found by using goal seek.

Pre-goodwill EPS accretion (dilution)

		Feb-08 restated	Feb-09	Feb-10	Feb-11
ABC					
EPS (pre goodwill)	p	11.53	12.22	13.62	14.96
Average shares	m	6,792.0	6,862.0	6,932.2	6,932.2
Net income (pre goodwill)	£m				1,037
XYZ (30%)					
Net income (pre goodwill)	£m				1
Adjustments					
Synergies (pre tax)	£m				350
Interest on synergies	£m				15
Interest on new debt	£m				15
Interest foregone on cash paid	£m				(11)
	£m				370
Tax thereon @ 28.0%	£m		(30)	(73)	(104)
Net income (pre goodwill)	£m	783	916	1,134	1,305
Enlarged average shares	m	6,792.4	6,863.1	6,933.7	6,933.7
Enlarged EPS (pre goodwill)	p	11.53	13.34	16.35	18.81
Accretion (dilution)			9.2%	20.0%	25.8%

Goal Seek

Set cell: F22

To value: 0%

By changing cell:

OK Cancel

Source: EPS sheet (To get Goal seek box Tools menu, Goal seek)

BS sheet

The balance sheet shows the proforma balance sheet post the transaction and calculates two credit ratios:

- Net debt / equity
- Net debt / capital employed.

The two sensitivity tables look at the impact on these ratios from changing offer premiums and equity proportions of consideration. These tables are driven by the sensitivity inputs on the Control sheet.

Sensitivities				
		model input	table input	increments
Offer price	$	4.03	4.03	0.30
Bid premium		35.0%	35.0%	10.0%

Source: Control (In) sheet

The table input (central value in data table) must be the same as the model input. As with all the other models, this is achieved by copying the values from the model input column to the table input column. The table inputs must not be linked into the model.

Checklist

Unless the checklist is fully completed and checked a message will appear on both the cover and the checklist sheet stating that the checklist is outstanding.

The checklist acts as a useful quick review of the model ensuring that key inputs are reasonable and defendable and that the model has been fully completed.

Merger II

Overview

If only EPS accretion (dilution) and pro-forma gearing outputs are required, it is suggested that the simpler Merger I is used instead of this model.

The Merger II model is intended to be used as a pitch model giving a greater variety of analysis and outputs than Merger I. It is a much larger and more complex model than Merger I.

In simple terms it calculates:

- Sources and uses of funds
- A pro-forma capital structure
- Forecast P&L (and subsequent ratios)
- Forecast balance sheet (and subsequent ratios)
- Forecast cash flow statements (and subsequent ratios)

- EPS accretion and synergies required for nil dilution
- Contribution analysis
- Value creation
- Implied credit ratings.

It can be quick to use, but as a minimum requires the inputs on the following sheets:

- The control page
- Bidder financials (historics and 3 years of forecasts)
- Target financials (historics and 3 years of forecasts).

Other inputs may be added but are not essential for the model to run. These add different levels of model functionality:

- Options
- Disposal (which also contains the disposal workings)
- Ratings.

Structure

The Control, Bidder and Target sheets (and, if applicable the Options, Ratings and Disposal sheets) drive the model.

The P&L sheet contains the principle workings.

The BS sheet contains the balance sheet workings.

The EV sheet principally contains workings for the charts.

The check sheet is a control to ensure the model is completed. There are also some controls on the headers of sheets which indicate when the model is not finished e.g. the data tables need updating, or the currency rate is inappropriate.

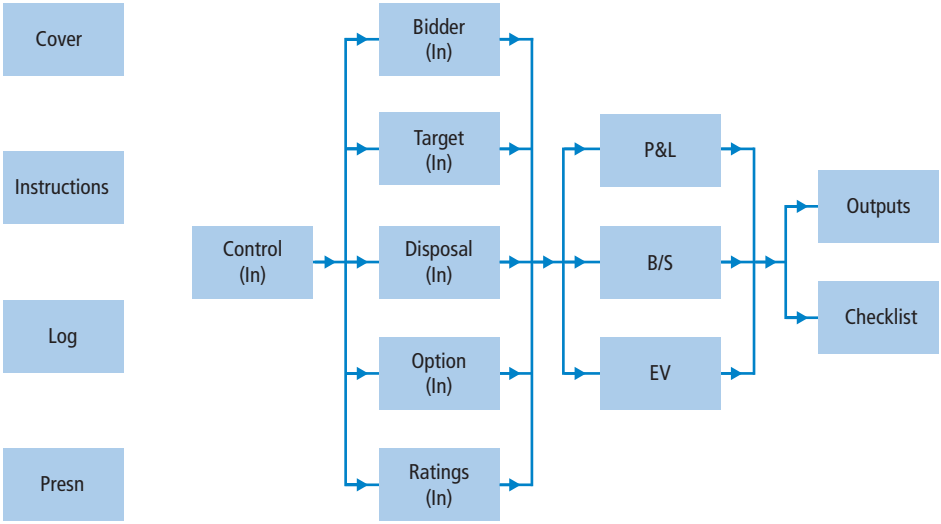


Diagram 1

The model has significant flexibility. It can cope with:

- Different currencies of Target and Bidder – the model can also cope with £ and p versus € and € for example
- Different year ends of Target and Bidder – see below for help
- Quoted or private Target (which can be valued in five different ways)
- Using up to date balance sheet values for capital structure
- Fair value adjustments to balance sheet values (and their subsequent unwind)
- Incorporating (or not) Target's share options and long term incentive plans
- Acquisitions from 50%-100% (though only if acquisition purchase accounted for – it cannot cope with equity accounting or proportional consolidation).

Dates

There are controls in place (via data validation of inputs) to ensure that only the appropriate year ends can be used in the model. For example, the transaction date must be after the historic year ends of both Bidder and Target but no more than 12 months later than the historic year end of the

Bidder. If the proposed transaction date is more than 12 months after the Target's historic year end, then a forecast "historic" year end must be used in the input.

The reason for this is the complexity of the pro-rating.

Sources and uses

The acquisition can be financed from cash, new debt or shares. The Target's debt may be refinanced and the new shares can be issued by way of a share swap (at no discount), a placing (with discount) or a rights issue (with discount).

		Share issue
New shares issued via ...?		rights issue
Discount on new issue		30.00%
Costs paid from proceeds of rights issue?		Yes
ABC share price	p	240.5
New ABC shares issued	m	639.3

Source: Control (In) sheet

The fees are split between equity issue fees, debt issue fees and M&A fees Each is treated differently. The equity fees can be paid from the proceeds of the equity issue or from other sources.

Uses		€m	
Purchase price of shares and LTIPs		5,218	
In-the-money element of 96m share options		64	
Total equity acquisition cost		5,282	*OfferTotal*
XYZ net debt		3,096	
Equity issue costs	3.00%	45	*EqCosts*
Debt issue costs	0.50%	18	*DebtCosts*
M&A fee		50	*DealExpenses*
Total financing uses		8,490	

Sources		€m	£m
Cash to be used in acquisition		286	200
Equity element	28.26%	1,537	1,076
New debt element		3,504	2,500
Debt financing of issue costs and M&A f		68	
XYZ debt rolled over		300	210
XYZ refinanced		2,796	1,957
Total financing sources		8,490	5,943

Source: Control (In) sheet

Goodwill

Goodwill is calculated as the offer value for the Target equity plus M&A fee less the net asset value (excluding goodwill) at the transaction date. To calculate the net assets at the transaction date the net assets per the last year end are taken plus any prorated profits between then and the transaction date.

If fair value adjustments are appropriate, these should be entered as one value.

The goodwill amortisation period can be selected. As goodwill is no longer amortised under IFRS or US GAAP, n/a should be input.

Goodwill amortisation can either be tax deductible or not (unlikely to be tax deductible).

The time period for the unwinding of fair value adjustments can be entered. These are likely to be the same as the lives of the asset (liability) to which they relate. This is subsequently treated as depreciation in the remainder of the model.

The fair value reversals can either be tax deductible or not (again these are unlikely to be tax deductible).

Goodwill		
	€m	£m
Offer value plus M&A fee	5,332	3,733
Identifiable net assets at acquisition of XYZ		
Net assets (per BS) @ 31 Mar 08 excl. MI	5,003	3,502
less: Goodwill (per BS) @ 31 Mar 08	226	158
Additional pro rated to 31 Dec 03	432	303
Fair value adjsutments	1,000	700
Add: Profit on disposal of FGH		-
Proforma net tangible assets at completion date	6,209	4,346
Proportion acquired		72.0%
Goodwill arising on acquisition		603
	FV adjs	**Goodwill**
Useful economic life	10 years	n/a
Unwind / amortisation charge	70	-
Is unwind / amortisation tax deductible?	☐	☐

Source: Control (In) sheet

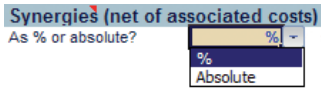
Synergies

There are three levels of synergies possible:

- Sales
- EBITDA
- Capex.

These are pro-rated in the year of acquisition.

They can be input either as absolute figures or percentages of the combined forecast sales, EBITDA and capex.



Source: Control (In) sheet

All synergies are presumed to arise wholly in Bidder (for tax and minority interest purposes).

The impact of each of the synergies on tax and the P&L, BS and CFS is calculated. For example capex synergies reduce forecast PPE, save cash which reduces net interest expense and increases tax. Lastly it reduces depreciation and so increases tax.

Disposal

Only one disposal may be planned. The relevant numbers can be input and then the model run either to include or exclude the impacts of the disposal.

Disposal			
Include disposal in calculations?	☑		
Disposal name		FGH	DisposalName
FGH is part of XYZ?	☑		
Gain (loss) on disposal is taxable (tax deductible)?	☑		
Date of disposal completion		31-Oct-08	DisposalDate
Disposal proceeds	€m	1,950	
	£m	1,365	DisposalPro

Source: Control (In) sheet

The disposal can be either a subsidiary or division of the Target or Bidder.

The disposal can take place any time after the historic year end of the entity (i.e. it could be before the acquisition date) and the end of the 3 year forecast period. It should be noted that the pro-rating to allow this is detailed.
A calculator check on the output numbers will give you comfort that the formulae give the right answer.

Disposal of FGH						
Date of report		25-Jul-08				
* extrapolated						
Disposal workings (£m)						
Disposal completion	31-Oct-08					
Disposal in year			yes	no	no	no
			Dec-08	**Feb-09**	**Feb-10**	**Feb-11**
Disposal year number	-	YearDisp	-	1	2	3
Proceeds timing & amount			1,365	-	-	-
Net assets at disposal - 31 Oct 08			691	-	-	-
profit (loss) on disposal			674	-	-	-
Tax on profit (loss) on disposal			202	-	-	-
MI on profit (loss) on disposal			-	-	-	-
% of period post-disposal			0%	15%	100%	100%
interest on proceeds			-	7	48	48
Tax on interest on proceeds			-	2	14	14

The calculation for the gain is relatively simplistic; it is calculated as sale proceeds less net assets at disposal date. This may or may not be taxable.

Ratings (In) sheet

The ratings sheet was added to the model after the model had been built to determine the credit rating of the combined entity.

The sheet is divided into three sections.

The top section shows the different credit ratings for different credit agencies at the offer price specified on the Control sheet.

The middle section requires user input.

Adjustments can be made to key metrics used by ratings agencies for the impact of operating leases and pensions and their effect on EBITDA, net interest and net debt.

Care should be taken with the pension adjustments. When adjusting the EBITDA figure it is important to know what the pension expense is that has been deducted within EBITDA. It is important that only the service cost has been expensed and there is no element of interest within the expense.

The forecast adjustments assume that the broker's forecasts have been calculated on a similar basis to the historics and will grow in line with staff costs (using growth in EBITDA as a proxy for this growth). This formula can be overwritten if this assumption does not hold true.

Any interest that has been taken account of within EBITDA must be removed from EBITDA and included within the net interest expense. The forecasts assume that the same net interest arises on future liabilities. Again this formula can be overwritten.

Net debt must be adjusted for the post tax unfunded pension deficit or surplus. Again the forecast assumes that the company will continue to fund the pension at the same level and that market values of the fund will not change. Again this formula can be overwritten.

Adjustments

£m		ABC Feb-08	ABC Feb-09	ABC Feb-10	ABC Feb-11	XYZ (calendarised) Feb-08	XYZ (calendarised) Feb-09	XYZ (calendarised) Feb-10	XYZ (calendarised) Feb-11	Adjustments Feb-09	Adjustments Feb-10	Adjustments Feb-11
Operating leases		147	156	165	165	56	87	87	87			
EBITDA	Unadjusted	1,642	1,912	2,151	2,436	723	725	834	931	446	166	223
100.00%	Operating leases	147	156	165	165	56	87	87	87	-	-	-
	Pension	(54)	(63)	(71)	(80)	22	22	25	28			
	Other											
	Adjusted	1,735	2,005	2,245	2,521	801	834	946	1,047			
Net interest	Unadjusted	125	158	185	195	53	34	49	68	96	(136)	(178)
33.33%	Operating leases	49	52	55	55	19	29	29	29	-	-	-
	Pension	(4)	(4)	(4)	(4)	16	16	16	16			
	Other											
	Adjusted	170	206	236	246	88	79	94	113			
Tax		288	373	423	490	127	144	163	179	164	212	256
Dividends		338	374	439	498	191	196	201	206	(104)	(87)	(65)
Net debt	Unadjusted	4,737	5,490	5,946	6,253	965	1,233	1,531	1,809	(3,594)	(4,387)	(5,098)
8.0x	Operating leases	1,176	1,248	1,320	1,320	448	696	696	696	-	-	-
	Pension	540	540	540	540	352	352	352	352			
	Other											
	Adjusted	6,453	7,278	7,806	8,113	1,765	2,281	2,579	2,857			

Source: Ratings (In) sheet

To find the present value of the operating leases for adjusting net debt a suitable multiple must be input. This multiple will depend on both the sector and the credit rating agency used.

The user can then choose one of five credit metrics for S&P and Moody's

- FFO / net debt
- RCF / net debt
- FFO / interest
- EBITDA / interest
- Net debt / EBITDA.

Thresholds

S&P	FFO / net debt	100.0	100.0	100.0	0.1	0.1	0.1	0.2	0.2	0.4	100.0	100.0	100.0	100.0	
		-	-	-	7.5%	10.0%	13.0%	16.0%	20.0%	35.0%					
Moody's				BB+	BBB-	BBB	BBB+	A-	A	A+	AA-	AA	AA+	AAA	
		100.0	100.0	100.0	0.1	0.1	0.2	0.2	0.3	0.5	100.0	100.0	100.0		
		-	-	-	9.5%	12.5%	15.0%	19.0%	33.3%	47.5%					
		2	Ba1	Baa3	Baa2	Baa1	A3	A2	A1	Aa3	Aa2	Aa1	Aaa		
Ratings			3	4	5	6	7	8	9	10	11	12	13		
	S&P	+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-		
	Moody's	1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3		

FFO / net debt
RCF / net debt
FFO / interest
EBITDA / interest
Net debt / EBITDA

...lds to the left of the ...t ratings should ...

...lds to the right of the last relevant rating should be blank.

There should be no blanks between the minimum and maximum.

Source: Ratings (In) sheet

The thresholds for each rating must be input. The user is told that any thresholds to the left of the first relevant rating must be put in as 0 and all thresholds to the right of the last relevant rating must be left blank.

For example in the screen print above: for S&P everything to the left of 7.5% must be 0 and everything to the right of 35% must be left blank.

The model works in default mode with the equity proportion as the driver of the consideration. Consequently, the implied ratings are driven from the sensitivity inputs relating to equity proportion. Therefore as the equity proportion changes, it impacts the amount of debt to be issued. If the debt issued is to be the input, then some back-engineering is required, using goal seek. Full instruction are given on the Ratings (In) sheet in the model.

Bidder sheet

This sheet is used to enter key P&L items, per share data, trading valuation multiples, net debt and shareholder funds information.

Target sheet

The sheet is laid out in three sections:

- Left section shows the inputs for P&L, net debt and shareholders' funds relating to the target (own currency, own year end)
- Middle section translates to Bidder currency and Bidder's year end
- Right – translation to Bidder currency but Target's year end. This is purely a working.

There is conditional formatting to allow for different workings depending on whether Target is listed or private.

P&L sheet

This sheet contains the main workings for the model.

The top of the sheet is a summary of the workings below.

There is a schedule for each of the three forecast periods, reconciling line by line the consolidation adjustments.

For the two later periods, the cumulative effects of the previous adjustments have to be taken into consideration.

At the foot of the page is a schedule which proves the net debt figures, but calculated independently – this is a control on the P&L schedules above – the unreconciled difference should be very small.

Net debt at year end	8,210	8,239	8,190
unreconciled difference	0.10	0.39	1.64
per combined	8,210	8,239	8,192

Source: P&L sheet

BS sheet

The top of the sheet is a summary of the workings below.

The Bidder and Target schedules below take out the impact of any disposal from the input numbers.

There is a working schedule for each year to account for any consolidation adjustments.

For example the first working strips out the goodwill of the target, brings in the goodwill arising on acquisition, accounts for the consideration as per the sources of funds and brings in the minority interest.

All adjustments are explained in the comment boxes.

Workings (all in £m)

				Pro forma at closing (31/12/08)		
	ABC	XYZ	perm. adj	disposal	other adj	Combined
New goodwill	-	158	284			443
JVs / associates	358	78				436
Other net assets	11,976	4,569				16,545
Net debt	(5,289)	(30)	(2,688)			(8,007)
	7,045	4,776	(2,403)			9,417
Equity	6,999	4,728	(3,683)			8,043
Minority interests	46	48	1,279			1,374
	7,045	4,776	(2,403)			9,417
	-					-

stripping out target's goodwill and replace it with new

new debt raised net of debt issue costs plus bidder's cash to be used

minority's stake in the (equity less original goodwill) of target

new equity raised less issue costs and stripping out target's equity

	ABC					na at Feb 09 Combined
New goodwill	-					443
JVs / associates	358					436

Source: BS

Unfortunately, much of the complexity in formulae arose due to dates and currency. For example, many formulae have to be able to cope with identifying whether the currencies of Target and Bidder are different and whether they have the same year ends.

It is suggested that a calculator is used to check some of the outputs as the formulae are sometimes long due to this flexibility.

Checklist

The final stage of the model completion is the checklist. This ensures that the model is working correctly, all assumptions are reasonable and defendable, and the data/sensitivity tables are updated.

Comps model

Overview

The comps model has two variants: the standard model and the "big" version. The only difference between the two is the number of companies that can be input. The standard model allows up to 15 companies to be input whereas the big version allows up to 25. However more companies can be inserted into each model.

The comps model has been developed to store the financials of companies within a particular sector. These financials create the comparable company analysis output for this model but can also be used to drive other models, principally the DCF models and merger models. This can be achieved by linking the inputs within these models to the inputs for the relevant company in the comps model. This can save an enormous amount of time.

Starting the model

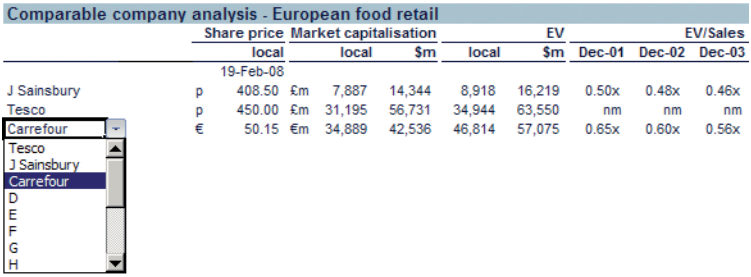
On opening the comps model, the model should be saved using the sector name.

The easiest way to do this is F12, select where you want the model to be saved and then type in the model name e.g. Comps Food Retail.

Output sheet

All of the outputs of the model are shown on one output sheet.

This sheet allows the user to select which companies and which multiples and ratios are shown.

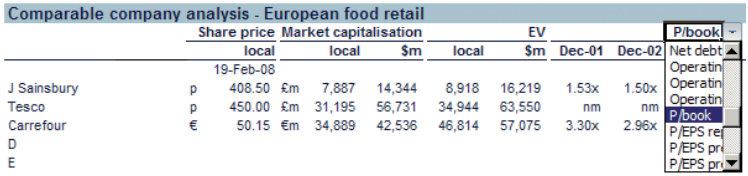


Comparable company analysis - European food retail

		Share price		Market capitalisation		EV		EV/Sales		
		local		local	$m	local	$m	Dec-01	Dec-02	Dec-03
		19-Feb-08								
J Sainsbury	p	408.50	£m	7,887	14,344	8,918	16,219	0.50x	0.48x	0.46x
Tesco	p	450.00	£m	31,195	56,731	34,944	63,550	nm	nm	nm
Carrefour	€	50.15	€m	34,889	42,536	46,814	57,075	0.65x	0.60x	0.56x

Tesco
J Sainsbury
Carrefour
D
E
F
G
H

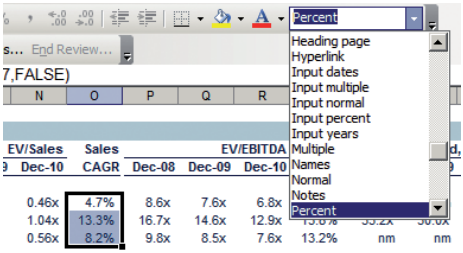
Certain things cannot be changed for example the share price.



Comparable company analysis - European food retail

		Share price		Market capitalisation		EV				P/book
		local		local	$m	local	$m	Dec-01	Dec-02	Net debt
		19-Feb-08								Operatin
J Sainsbury	p	408.50	£m	7,887	14,344	8,918	16,219	1.53x	1.50x	Operatin
Tesco	p	450.00	£m	31,195	56,731	34,944	63,550	nm	nm	Operatin
Carrefour	€	50.15	€m	34,889	42,536	46,814	57,075	3.30x	2.96x	P/book
D										P/EPS re
E										P/EPS pr
										P/EPS pr

On changing the multiple or ratio shown, the user must ensure that the outputs below are shown using the correct format. For example, if instead of looking at an EV / Sales multiple, sales growth is selected, the results below must be changed from a multiple format to a percentage format. This is not done automatically but can be done easily by selecting the appropriate style from the style drop down box.

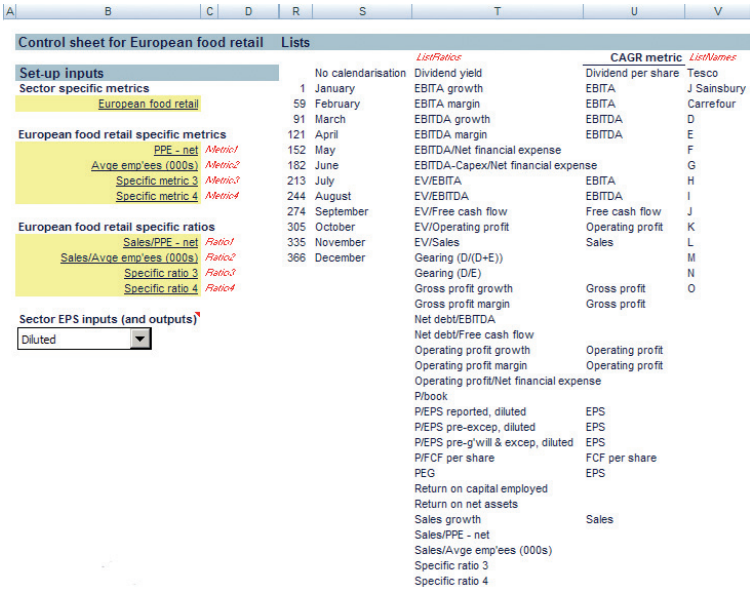


Control (In) sheet

The relevant sector is input into B6.

In cells B9 to B12 up to 4 specific metrics can be added in.

In cells B15 to B18 up to 4 specific ratios can be defined. The model warns the user that manual calculations are required for all user defined ratios . Formulae for these ratios need to be input in cells AC42 to AE45 on all company sheets.



Control sheet for European food retail

Set-up inputs

Sector specific metrics

European food retail

European food retail specific metrics

PPE - net	Metric1
Avge emp'ees (000s)	Metric2
Specific metric 3	Metric3
Specific metric 4	Metric4

European food retail specific ratios

Sales/PPE - net	Ratio1
Sales/Avge emp'ees (000s)	Ratio2
Specific ratio 3	Ratio3
Specific ratio 4	Ratio4

Sector EPS inputs (and outputs)

Diluted

Lists

ListRatios		CAGR metric	ListNames
	No calendarisation	Dividend yield	Dividend per share	Tesco
1	January	EBITA growth	EBITA	J Sainsbury
59	February	EBITA margin	EBITA	Carrefour
91	March	EBITDA growth	EBITDA	D
121	April	EBITDA margin	EBITDA	E
152	May	EBITDA/Net financial expense		F
182	June	EBITDA-Capex/Net financial expense		G
213	July	EV/EBITA	EBITA	H
244	August	EV/EBITDA	EBITDA	I
274	September	EV/Free cash flow	Free cash flow	J
305	October	EV/Operating profit	Operating profit	K
335	November	EV/Sales	Sales	L
366	December	Gearing (D/(D+E))		M
		Gearing (D/E)		N
		Gross profit growth	Gross profit	O
		Gross profit margin	Gross profit	
		Net debt/EBITDA		
		Net debt/Free cash flow		
		Operating profit growth	Operating profit	
		Operating profit margin	Operating profit	
		Operating profit/Net financial expense		
		P/book		
		P/EPS reported, diluted	EPS	
		P/EPS pre-excep, diluted	EPS	
		P/EPS pre-g'will & excep, diluted	EPS	
		P/FCF per share	FCF per share	
		PEG	EPS	
		Return on capital employed		
		Return on net assets		
		Sales growth	Sales	
		Sales/PPE - net		
		Sales/Avge emp'ees (000s)		
		Specific ratio 3		
		Specific ratio 4		

The user has the choice of using either basic or diluted EPS. All companies within the sector will then have this as the standardised EPS for inputs and outputs (this switch should not be subsequently changed).

Column T shows the ratios that have been built into the model. T34 to T37 will change automatically according to the specific ratios chosen in B15 to B18.

All other controls do not need changing until the outputs stage.

Company input sheets

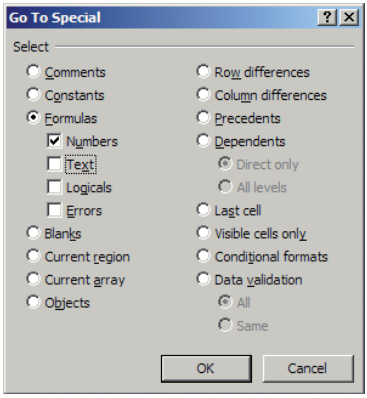
The model contains old data on the sheets Tesco, Sainsburys and Carrefour. This needs to be removed.

Before doing this these three sheets must be unprotected. This can be done by going into Tools: then Protection: then Unprotect.

The most efficient way to remove the old data is to select the Tesco, Sainsburys and Carrefour sheets together but staying within the Tesco sheet.

All inputs (shown in the yellow areas) need to be deleted. All hard numbers can be selected using the F5 button. Press F5: then select Special. From the box that appears select Constants. At this point Numbers, Text, Logicals and

Errors become checked. As only hard numbers need to be identified Text, Logicals and Errors need to be unchecked.



All hard numbers are identified and these can be deleted in one go.

As not all inputs are hard numbers, all other inputs in the area from A1 to BU 182 must be deleted.

Once this has been done deselect the 3 sheets and rename E7 in each sheet as A, B and C respectively. The sheet tabs should also be named Co A, Co B and Co C respectively.

The model is now ready to input.

Leaving a spare sheet

The model works best when all but one of the companies are used. One company for example Company O is left blank.

There are two key reasons for this:

- The first is that it allows Company O (a blank company) to be selected on the output page thereby allowing for some companies to be eliminated from the output.

For example if 14 of the 15 companies have input information, yet only 8 are required for the current version of the output, then the 8 companies can be chosen and Company O can be selected 7 times, thereby eliminating 6 input companies from the output and the averages.

- The second reason is that it allows Company O (a blank company) to be used as the template for when additional companies need to be added.

Company inputs

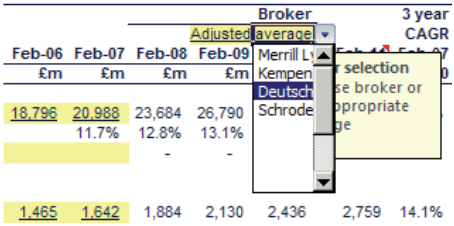
For each company fill in all the yellow input cells if applicable.

Cell E9 gives the user a drop down list for the appropriate currency. If for example £ is chosen then the share price in cell E11 is shown automatically as "p".

All numbers should be shown as positive numbers unless indicated otherwise. For example net financial expense should be shown as a positive number. But decrease in working capital should be shown as a negative as indicated by the text W'king cap incr (decr).

Brokers numbers are in put in lines 56 to 65. Up to 10 brokers can be input into the model. An average of the broker metrics is calculated by the model as can an adjusted average. For an adjusted average the user must state which brokers are to be excluded.

A drop down box in O7 allows the user to decide whether the forecast metrics are based on a specific broker or an average or adjusted average.



To calculate the enterprise value of the company rows 75 to 179 must be completed. These then feed into the component parts of the enterprise value. The A column indicates whether each component is being added or subtracted.

	Enterprise value	
	Net debt @ market value	3,104
+	*Minority interests - book value*	36
+	*Preference shares @ market value*	-
-	*Associates/JVs & other investments - book value*	(340)
+/-	*Pensions & other adjustments to net debt*	-
+	*LTIPs buy-out value at 19 Feb 08*	-
+	*Share options buy-out value at 19 Feb 08*	949
+	*Market capitalisation at 19 Feb 08*	31,195
	Gross equity value at 19 Feb 08	32,144
	Enterprise value at 19 Feb 08	34,944

Net debt, Minority interests, JVs and associates and preference shares can be shown at market value if the information is available. If no market values are entered, the model will tell you they are missing and state that book values are used instead.

Again to calculate net debt all numbers must be put in as positive numbers. The formula for the total net debt will subtract the cash and cash equivalents.

Any share options should be input in lines 152 to 179. The model will automatically calculate which options are in the money and exclude those that are out of the money. Only those that are in the money are taken into account in the enterprise value.

Share options buy-out value at 19 Feb 08

	All Options		Options in the money		
Scheme	No of shs (in m)	Exercise Price (p)	No of shs (in m)	xercise 'rice (p)	
Savings related share scheme	-	-	-	-	
01-Oct-03	4.0	83.30	4.0	83.30	
01-Oct-04	26.9	83.00	26.9	83.00	
01-Oct-05	25.6	121.70	25.6	121.70	
01-Oct-05	57.6	136.00	57.6	136.00	
01-Oct-06	43.9	151.00	43.9	151.00	
01-Oct-00	48.3	198.00	48.3	198.00	
Irish schemes	2.8	169.00	2.8	169.00	
Executive share scheme	-	-	-	-	
1994 scheme	3.6	85.00	3.6	85.00	
1995 scheme	4.2	101.00	4.2	101.00	
01-Jul-01	1.3	98.30	1.3	98.30	
01-Sep-02	5.5	99.70	5.5	99.70	
01-Apr-02	7.6	117.70	7.6	117.70	
01-Oct-02	4.2	151.70	4.2	151.70	
01-May-03	23.7	176.70	23.7	176.70	
01-Sep-03	1.4	164.00	1.4	164.00	
01-Jan-03	24.7	178.00	24.7	178.00	
01-May-04	1.4	179.40	1.4	179.40	
01-Nov-04	3.4	180.00	3.4	180.00	
01-Apr-06	2.1	209.50	2.1	209.50	
01-Jun-06	27.3	205.00	27.3	205.00	
			-	-	
			-	-	
			-	-	
			-	-	
			-	-	
			-	-	
Total shares	319.5		319.5		
Weighted average exercise price		152.87		152.87	
Share price as at 19 Feb 08 (p)				450.00	
Options' net buy-out price				297.13	
Buy out value (£m)					949

NB

- It is important that all numbers that are input are normalised and comment boxes should be inserted to tell the reviewer the source of the numbers input

- Once all company information has been input the output sheet should be checked. If this is full of error messages the relevant companies must be selected on the output sheet and a relevant standardised year end must be selected from the drop down list in B:D26 on the Control (In) sheet
- There is the option to have a standardised year end or no calendarisation.

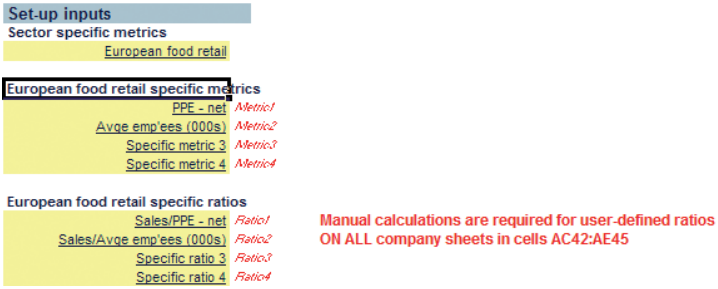
Sector-specific ratios

If sector specific ratios are required the following sheets must be amended.

Control (In) Sheet

Up to four specific metrics and four specific ratios can be selected. The model will adapt for the metrics and ratios selected.

If for example the PV of the future lease rentals needs to be calculated this can be done in a blank area on each company input sheet, however an input could be created on the control sheet for the capitalisation factor to be used.



Company input sheets

Once data has been input for the first company all company input sheets should be selected with the first company sheet as the visible sheet.

Go to cell AC42 (it has a yellow background, is un-protected, but requires manual calculation). Copy the formula (but not the formatting) from one of the cells above. The formula has an IF statement to toggle between the result under no calendarisation (this refers to cells to the right in AH11:AK45); and if calendarisation is selected (this refers to cells to the left in T11:W45).

[Note: conditional formatting whites-out the deselected option so this is where a grey window background is useful to view the model]

The formula must be edited in both parts of the If statement.

[Note: if part of the equation refers to a named cell (e.g. EVCoA), then this will cause problems when copied to other sheets; instead use the cell reference and create as an absolute reference (e.g. $E$36 for the EV)]

The formula must be copied to all 3 years. It is very important that the formulae are sense checked at this stage to make sure they are working correctly.

Once all the formulae have been completed, un-protect each sheet (if not yet unprotected) and then format the formulae appropriately using the styles drop down list on the toolbar. If styles are used then protection, colours, decimal places etc. will automatically update.

The specific ratios will now be added to the ratio drop down lists on the outputs sheet.

Inserting additional companies

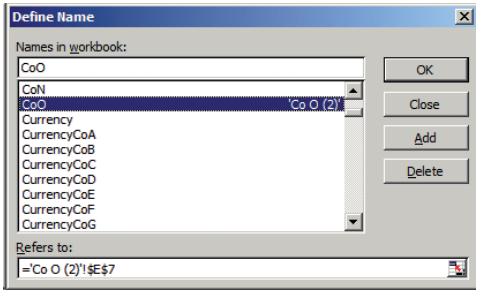
The following steps must be done in order. It should be noted that each new company adds around 100KB to the model size.

Company input sheets

Copy the blank sheet Co O once. This can be done by right clicking on the sheet name: then selecting Move or Copy and then selecting the sheet to be copied and then checking Create a Copy.

Before any amendments can be made to Co O(2) the protection must be removed.

Using the CONTROL F3 function delete 12 names (all ending in CoO) – they should all stand out as they have 'Co O (2)' in the right-hand column.



[Note: the Print_Area also has the 'Co O (2)' in the right-hand column – this should not be deleted]

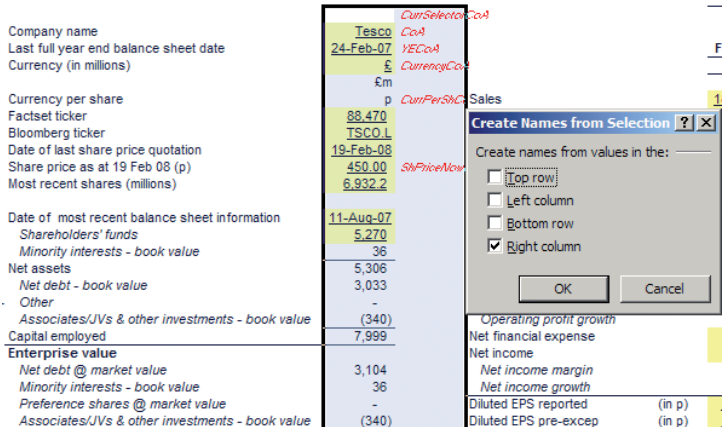
Give the company a name, for example Co P, and name this cell by writing the name of the cell to the right, formatting it using the Name style and then create the name.

Sheet Co O (2) can be copied as many times as is needed (remembering to always leave one blank company and that each new company can add up to 100KB to the model).

On each new company replace the text P and CoP with Q and CoQ, R and CoR, S and CoS etc. and rename each sheet appropriately.

On each new sheet (from P onwards), create 12 names as follows

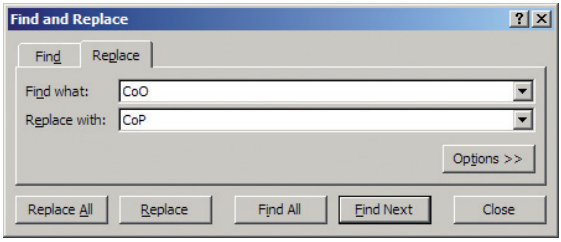
- 8 cells in column E using the names in column F (select the cell to be named and the name. Press CONTROL SHIFT F3 and ensure right column is selected):



- 3 ranges in K3:P5 using the names in column Q (use CONTROL SHIFT F3)
- 1 range in Y8:AF50 using the name in Y7 (this will have to be done manually, as CONTROL SHIFT F3 will not work in this situation). The name can be typed directly into the name box once the area to be named has been selected.

On each new sheet (from P onwards), replace inappropriate names in formulae (names ending in CoO currently remain on all new sheets, whereas the new names created above are the appropriate names).

This can be done using CONTROL H (Edit, Replace) with no particular cell selected:



- Find what: CoO
- Replace with: CoP (or CoQ etc. depending on sheet)
- Replace All.

The inputs sheet for the new companies must now be protected again once all the steps above have been completed.

Workings sheet

Once again before any changes can be made to the workings the protection on this sheet must be removed.

Insert the appropriate number of rows for the number of the new companies immediately below O in both tables i.e. working table 1 and working table 2. So long as the new companies are inserted immediately below O then the range names (working table 1 and working table 2) will automatically stretch to include the new companies.

The contents of O must be copied down to each new row inserted.

In each new row in both tables, replace inappropriate names in formulae. Currently names ending in CoO appear in all new rows, whereas the new names created above are the appropriate names to be used.

Again the control H function can be used but this time it must be done on a row by row basis. Each row must be selected before the control H function is used.

In each new row in both tables, replace "O" with appropriate company name.

- Highlight the new row (one by one)
- Using CONTROL H (Edit, Replace)
- Find what "O" the quotation marks are necessary
- Replace with "P" (or "Q" etc. depending on sheet)
- Replace All.

Re-protect the sheet if required.

Control (In)sheet

On the input sheet remove the protection as before (if required).

The only step on the input sheet is to add all the new company names to the bottom of the list of company names (using the names as defined above).

Rename the ListNames to include the new company names.

Once this has been done the sheet can be re protected (if required).

Output sheet

The output page should be amended as below only if more than 15 companies are required for outputs.

Once again remove the protection on the sheet.

Insert the appropriate number (according to the new companies created) of rows before O in both tables.

Copy a completed row into the new rows and select the appropriate company name(s).

When all of these steps have been completed re-protect the sheet (if required).

Inserting additional currencies

Control sheet

For each new currency, the currency table must be extended by both one row and one column. In order to automatically stretch the range names (ListCurrency and CurrencyConvertor):

- Insert a row(s) below the Euro line and
- Insert a column after the Euro column
- Ensure that all input cells are identified and all formulae are extended.

This should have no effect on any other names due to the location of the currency table.

Financial modelling

8 • Financial modelling

Introduction

This chapter sets out how Excel can be controlled and exploited to enable:

- Faster and more efficient use of Excel tools
- Better understanding of model design principles
- Reliable, robust and flexible models to be built
- Improved efficiency in identifying inconsistencies when auditing financial models
- Better analysis and sensitivity assessment of financial models.

The aim is to provide the practical skills to build, modify and audit an integrated and flexible financial model.

Meeting user needs

The most common complaint about spreadsheet models is that they cannot be understood. The lack of understanding could be a problem for users other than the modeller, or even the modeller himself / herself when the model is revisited.

This complaint arises because models:

- Are rarely documented
- Include cumbersome formulae (difficult to understand, check and modify)
- Include wide and / or long spreadsheets
- Only contains numbers (a graph can quickly highlight results)
- Have no consistent format
- Mix the assumptions, other inputs, workings and outputs.

Useful models are those that can be picked up and easily and quickly understood by a reviewer. The more logical, consistent and rigorous the model, the more confidence will be engendered in the results.

These notes should help ensure that models are not only logical, but can also be reviewed by others with the minimum of effort.

N.B.: In most cases new projects will be modelled **using existing models** that are subsequently adjusted to fit the purpose of the proposed transaction.

Excel vs. modelling

Excel is a particularly powerful application which can be used to generate, analyse and present both simple and complex data. Like any sophisticated tool, when used properly, it can be harnessed to create highly efficient, interactive and robust financial spreadsheets.

The skills introduced by financial modelling harness the functionality of Excel within a methodical and rigorous financial framework which can be applied to a large number of different applications.

Financial modelling, therefore, combines:

1. Financial skills

- The strategy of the business or project
- The product, project or industry competitive dynamics and their value-drivers and key sensitivities
- Accounting, analysis, forecasting, structuring and / or valuation techniques.

2. Excel functionality

- Knowledge of the mechanics of functions and tools
- How to practically apply the functions and tools
- Practical limitations of the functions and tools.

3. Robust spreadsheet modelling techniques

- Design principles
- Modularity
- Quality controls and diagnostics
- Version control
- Formulae conventions
- Format conventions
- Logical thought
- Data analysis and sensitivity.

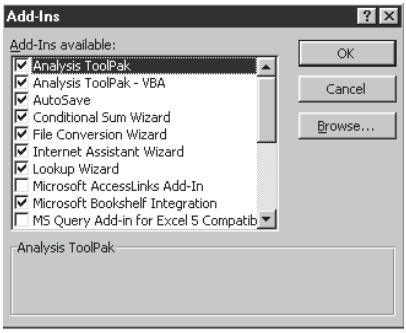
Excel set up for efficient modelling

In order to use Excel efficiently, it is worth ensuring the profile (where possible) has been amended for the following:

Autosave

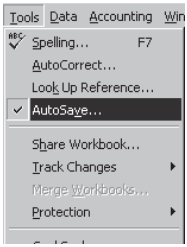
For users of Excel 2003 and higher, Autosave will automatically run in the background and so no action is needed.

For users of versions earlier than Excel 2003 Autosave should be available on the Tools menu, but if it is not it must be added in. To do this, select Tools, Add-Ins and the following dialogue box will appear. (This may require the programme disks.)



Check the Autosave box and press OK.

When complete, clicking on the Tools menu should reveal a new fourth item:



To change the settings for AutoSave or switch it off, click on Tools; AutoSave and a simple dialogue box will appear.

Autosave, like many Microsoft innovations, is controversial amongst modellers and a double edged sword. If you follow the saving procedure, then Autosave is a useful tool. Crashes will not worry you and you will not worry either about saving, only to realise that you accidentally deleted a sheet 10 minutes ago. The worst position you will be in will be to lose a mornings work. Most of the time, you will only lose 5-10 minutes.

Analysis ToolPak

The standard set-up of Excel is fine for most users. However, in some financial models, some more advanced statistical tools and / or date functions are needed. These tools and functions are within the Analysis ToolPak, which must be added in the same way as Autosave:

Tools; Add-Ins; tick the Analysis ToolPak box; OK

Note 1: If you are logged into the network at the time of doing this, your profile will be updated so that these advanced functions are available for all future sessions.

Note 2: If the model is to be sent to others, they may not have incorporated this add-in and so some of the calculated formulae may appear as #NAME?. It may be necessary to indicate that the user must go through the add-in routine to ensure the model works effectively.

Calculation settings

Tools; Options; Calculation tab

1. Ensure the Iteration box is not selected

If the Iteration box is selected, Excel will iterate any circularities created within the model. Circularities make models slower to calculate, unstable and more likely to crash. Often circularities within models are created in error or are unnecessary. Whilst the iteration option remains off, any circularities will be flagged (and can be eliminated).

Note: if a circularity exists and the iteration option remains off, the calculated numbers in the model cannot be trusted.

2. Select Automatic except tables

The model will calculate automatically as the model is modified, but F9 must be pressed whenever Data Tables are to be calculated (see Data Tables later).

Consequently, when constructing a model, the iteration should remain off so that any circularities are identified and eliminated (if necessary) as they arise. However, when using previously created models in which circularities exist, e.g. in infrastructure projects with regulated accounts, or where it is the intention to create a circularity, then the iteration should be switched on.

Grey background

Following this procedure Excel (together with all other applications) will appear on screen with a grey background. It is merely the screen colour that has changed – the document will continue to print out and be viewed by other users in the same way as before the change.

The benefit of such a change is to allow white text to be used in the model – this can be read on the screen (against the grey background) but will print out as white (probably on white paper) and so be invisible. This can be used for row / column counters, checks etc. which may otherwise confuse the reader of the printed model.

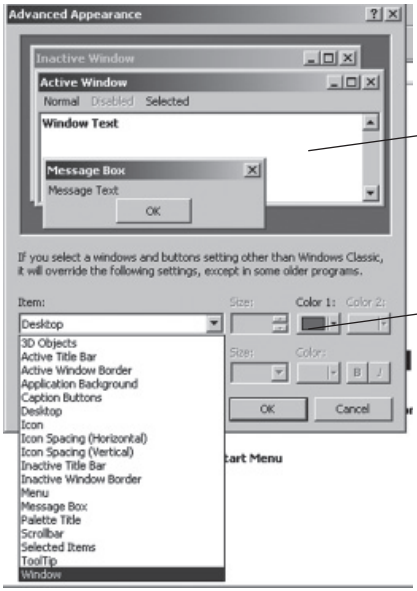
To set the profile to grey:

> Start; Settings; Control Panel; Display; Appearance (Advanced Appearance on some versions of Windows).

[Alternatively:

> Right mouse on desktop; Properties; Appearance (Advanced Appearance on some versions of Windows).]

Select Desktop, Window, and select colour grey. Alternatively, click on the window text area and then alter the colour below to grey.



Note: There will be other ways in which you may choose to change your profile as you will see throughout these notes, for example modifying the toolbar to include the auditing toolbar.

Model set up

Design

Time spent on design is never wasted and will be recouped many times over while building a model. Clear design objectives at the start (which do not change) will enable a simple and straightforward model to be built, which should also be transparent in structure, making it easy to use and easier to find any mistakes.

The first step is to scope out the model. The following questionnaire aims to help uncover the key issues which will drive the way the model is structured and which will also determine the user friendliness and flexibility that is required.

The questionnaire is for modellers to gather responses from the potential users and consumers of the results (these may be different people).

Scope questionnaire

1. Who is the customer? Who wants the outputs and why? What are detailed questions the model will be used to answer? What are the important outputs? Is there a mandatory or preferred format for them? What are the key decisions which need to be made based on the outputs?
2. What is the nature and form of the input data? How detailed and high quality will it be? Can you set the format, or get a commitment to format from the input data's author?
3. What is the legal entity or group being modelled? Is this uncertain or likely to change?
4. Will the model be published in printed form in a prospectus or similar? Will it be issued to third parties in electronic form?
5. Will the model be formally audited by a third party?
6. What will the role of the model ultimately be? For example:
   - A "one off" piece of analysis as part of a larger study
   - A standard model to be used as a template for analysis
   - The main forecasting tool to establish the structure and amount of a public finance raising.

7. What are the critical value drivers which will need to be flexed into the model, and what are the key operating links, e.g. working capital / sales?
8. What is the range of structures of company or transaction which will need to be examined by the model?
9. Are timing assumptions likely to change in the model, e.g. do you plan to still be using the model in a year's time when all forecasts will need to start a year later? Is the timing of events in the model likely to change, e.g. an acquisition, a divestment, the start of operation of a project? If in doubt assume the worst.
10. What detailed questions will the model answer?
    - Valuation
    - Financing structure optimisation
    - Liquidity planning.
11. Will borrowing or holding assets in foreign currencies need to be modelled?
12. Will there be large changes in the level of debt?
13. Will there be significant seasonality in cash flows or revenues?
14. What will be the inflationary environment of the company being modelled; will real and nominal forecasts be required?

The answers should enable the modeller to do the job clearly understanding the levels of usability and professional polish that the model requires.

Questions 7-14 are particularly important because they are the typical issues of "detail" that may not be discussed at an early stage, but which will have a fundamental impact on design approach. It will be difficult to bring these issues into a model which is already well developed. Again, planning and providing for a particular development from the start will make a model easier to work with throughout its life.

Standard models

A model is inevitably a very specific answer to a set of very specific questions. A line of thought that occurs at some stage to anyone involved regularly in modelling is: "A good standard model will simplify my life and instead of building models I can focus on analysis."

This is perfectly reasonable but this strategy has practical shortcomings. Creating a standard model will constrain analysis. The standard model will always make the same implicit assumptions; treat companies / projects / data in the same way; and make the same approximations.

Because it is not always appropriate to look at companies / transactions in the same way or because some companies / transactions are very different, standard models tend to develop in two ways:

1. They become very simple.

   The result being that the analysis is largely outside the model and only a small number of key variables are used to get results.

   If the model only performs limited analysis, it will only help in a limited way with decision-making. What a good model should do is give integrated and consistent analysis from which decisions can be made.

2. They become complex with lots of flexibility, alternative inputs and calculation sections which can be used as necessary.

   Large, complex models can become unwieldy and, if the users are not trained or do not regularly use all parts, sections fall into disuse because people do not understand them, do not trust them or just do not know what they do.

   Many teams have one of these "all singing, all dancing models" and they are often forsaken, not because of any quality problems but because of lack of confidence on the part of users and lack of familiarity.

Clear, specific objectives supported by documentation and training is very important for the success of a standard model. For a standard model of any complexity, documentation and training are essential.

For any standard model to be accepted the analysis it does and the outputs it produces must be relevant to the decisions to be made by users. This means consultation and clear design scope.

Model structure

The structure of a model will be a function of the results of earlier work in understanding the modelling needs. In particular, the output desired, the level of detail required and the degree of flexibility necessary will have been determined in advanced.

Good model design has a logical structure in which different modules are separated into separate sheets in a workbook. A standardised rule-book for the creation of the various sheets will aid easy construction and review.

The most common structure for financial models is Assumptions; Process; Results: i.e. inputs followed by workings followed by outputs. However, no matter what kind of model is being built, it should have a further three elements giving a minimum structure of six key building blocks:

1. Log sheet
2. Description sheet
3. Checks sheet
4. Assumptions (or input) sheet(s)
5. Workings sheet(s)
6. Output sheet(s).

By creating separate sheets for each of the building blocks of the model, a reviewer is able to build up knowledge of the model step-by-step: model genesis, model description, checks, assumptions, process and results. It aids clarity of thought and is easier to maintain, view and print. The twin disadvantages of lengthier formulas and file size are more than outweighed by these advantages.

1. Log sheet

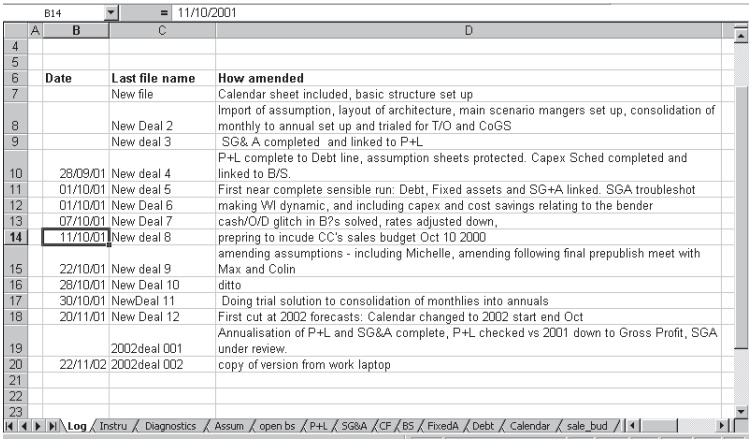
Modellers face two contrasting problems:

- Having different "current" copies of the same model; or
- Only having one copy of the model.

Working on the move, at home, on laptops or at clients' offices gives rise to various copies, all with the same name and perhaps with only minor but significant differences between them. Particularly when under pressure, it is easy to waste time trying to figure out which is the latest version.

Keeping only one copy can give problems which are more fundamental. Crashing computers which corrupt the model, bad design or changing design needs may leave the modeller wishing he could go back a day or two to get back to an undamaged copy or to avoid unpicking work.

A common practice amongst modellers is to keep a log sheet in each model and to adopt a rigorous saving procedure. A typical log sheet looks like this:



B14 = 11/10/2001

	A	B	C	D
4				
5				
6		**Date**	**Last file name**	**How amended**
7			New file	Calendar sheet included, basic structure set up
8			New Deal 2	Import of assumption, layout of architecture, main scenario mangers set up, consolidation of monthly to annual set up and trialed for T/O and CoGS
9			New deal 3	SG& A completed and linked to P+L
10		28/09/01	New deal 4	P+L complete to Debt line, assumption sheets protected. Capex Sched completed and linked to B/S.
11		01/10/01	New deal 5	First near complete sensible run: Debt, Fixed assets and SG+A linked. SGA troubleshot
12		01/10/01	New Deal 6	making WI dynamic, and including capex and cost savings relating to the bender
13		07/10/01	New Deal 7	cash/O/D glitch in B?s solved, rates adjusted down,
14		11/10/01	New deal 8	prepring to incude CC's sales budget Oct 10 2000
15		22/10/01	New deal 9	amending assumptions - including Michelle, amending following final prepublish meet with Max and Colin
16		28/10/01	New Deal 10	ditto
17		30/10/01	NewDeal 11	Doing trial solution to consolidation of monthlies into annuals
18		20/11/01	New Deal 12	First cut at 2002 forecasts: Calendar changed to 2002 start end Oct
19			2002deal 001	Annualisation of P+L and SG&A complete, P+L checked vs 2001 down to Gross Profit, SGA under review.
20		22/11/02	2002deal 002	copy of version from work laptop
21				
22				
23				

Log / Instru / Diagnostics / Assum / open bs / P+L / SG&A / CF / BS / FixedA / Debt / Calendar / sale_bud /

Saving procedure

The log sheet is maintained as part of a saving procedure.

1. When commencing a development session where you will be editing the model, on opening the model, record the name of it in the log sheet on a new line, make some quick notes of what you are planning to do to it and before you commence work, save the model with a new name and use sequential (or date) naming, i.e. give each draft a reference number but otherwise keep the name the same
2. Switch on Autosave, but leave the prompt checked so that Excel only saves when you want rather than when it wants to. For users of Excel 2003, Autosave will automatically run in the background
3. Regularly save material when you are happy with the alterations you have made and keep a record in the log sheet
4. At a milestone in development, or when you start another session go back to step 1 and start the saving routine again.

Although the procedure may seem like a chore, it will give a clear idea of where you are in development, if you reconsider design or have to make important changes / throw out part of the structure, the log sheet will give you another clear option, i.e. to go back to an older version and start again, instead of "unpicking" unwanted code out of the model.

2. Description sheet

A properly documented model can be picked up and understood by others relatively easily.

It is useful to have a separate worksheet with instructions on how to run the model. This will allow other users to understand how to operate the model, especially when additional or non-conventional procedures are needed to make the model work correctly. Common errors and their solutions should also form a part of this sheet.

The genesis of the model can be reviewed by looking at the log sheet (see above) and the checks sheet (see below) should be reviewed in order to verify that there are no red flags.

However, additional assistance can be derived from a description sheet containing the following:

- Description of the proposed transaction / analysis

  This brief description should:

  - Describe the purposes of the model
  - Identify the key assumptions and where they are to be found
  - Identify the key outputs
  - Give instructions as to how to run the model.

When done properly, this will help set the context for the model and so make it easier to use.

- Implicit assumptions / presumptions

  Certain preconditions exist within each model which may be obvious to the modeller but unknown to subsequent users (e.g. that all cash flows arise at the end of each period; or the model is not time flexible).

  These implicit assumptions limit the scope of the model and so should be briefly set out on the description sheet.

- Model flow

  For more complex models, a description of the links within the model (and, better still, flow diagrams) will help users understand the structure of the model and make review and auditing easier.

- Author / checker

  By giving details of those who have worked on the model ownership is assigned.

  Additionally, the name and contact details of the author (and the date of their last efforts) may be useful if questions need to be asked. If the model has been reviewed, similar details for the checker gives a second port of call.

Additionally, adding explanatory notes into the model allows other users of the model to understand aspects such as assumptions, formulae etc. that may be neither obvious nor commonly used.

It is important to keep the explanatory notes up to date whilst the model is built. It can be hard to remember what has been done when the model nears completion.

3. Checks sheet

When a model goes wrong, the modeller needs to know. It would be unprofessional and embarrassing to print or send out a model with errors. To help in quickly identifying these problems a checks area is used. All diagnostic checks from the model are housed in this part of the model.

For larger models with significant checks, this will form a sheet in its own right. For smaller models, this may be housed on the output or description sheet – an example of which appears below.

Key assumptions		
The model is intended as an aid in deciding whether a company looks potentially attractive as an LBO proposition - i.e. whether there are enough cash flows to service debt and whether the broad equity return is sufficient. Consequently, only one equity return is shown. All exit valuations are calculated on the basis that exit happens at a calendar year end. All cash is used to pay off debt / accumulate cash: there is no return to equity until exit. All equity is introduced as straight equity. Senior A debt is amortised using all available free cash flows until fully repaid. Senior B, Senior C, Mezzanine and High yield are repaid by way of bullets in the final year of the debt term (not all classes of debt need be used). All interest is cash interest. The Mezzanine debt is straight debt with no warrants attached. The checks and controls within the model assume that all Senior A must be repaid from cash flows but that tranches B&C may need to be refinanced at maturity if an exit is not achieved earlier. The revolver is used when cash flows and scheduled debt payments cannot be met. Interest on the revolver can be calculated on opening, closing or average balances - the closing or average balance creates circularity and should be used with iteration only. The aim of the revolver should be to meet short term cash flow deficits, yet the model projects only annual cash flows. The result is that the model uses the revolver to highlight financing problems. Consequently, no cap nor facility fees are relevant for the revolver.		
Checks		
Sensitivity tables		OK
Equity value creation		Equity value creation calculation OK
Expected equity IRR		27.4%
Senior A debt		
Total FCF for debt repayment in 6 yrs	£m	906
Senior A debt borrowed for 6 years	£m	900
% senior A debt repaid after 4.25 years		59.1%
% senior A debt repaid after 6 years		100.0%

4. Inputs & assumptions

Keeping all of the inputs and assumptions (i.e. the model drivers) in one place is an essential element to any model. The user needs to be confident that they can control the model from this single assumptions section. Having inputs dotted throughout the model adds to the complexity of using and reviewing the model.

Additionally, there are some Excel tools which require like items to be grouped on the same sheet. The most common of these is the Data Table which is used to check the sensitivities of key assumptions to key outputs. Data Tables can only be created on the same sheet as the assumptions.

The exception to this idea of keeping all of the inputs in one place is historic (financial) figures. Although inputs should go on the inputs page, historic financials are facts rather than assumptions driving future value, and so it is reasonable to put them on the appropriate sheets (e.g. P&L historics on P&L sheet).

Control panel

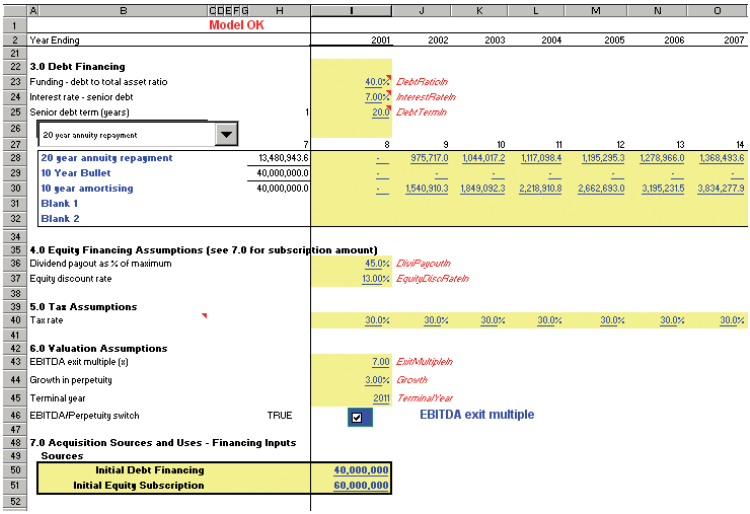
Having a separate assumptions sheet (or sheets) is good discipline in any model and a logical development is to integrate a control panel into it.

A control panel is simply an area of the assumptions sheet (or sheets) where all of the switches, list boxes and other controls which are used to select scenarios and pick particular calculation bases are placed.

It is not unusual for some of the key outputs from the model to be linked back to the control panel area, so that the impact of changing switches or scenarios can be seen immediately.

The fundamental design issue here is that once the model is built, it needs to be easy to use, and that means that it must be easy to input data and to see the results changing as this is done.

The following is an example of a control panel on an assumptions sheet from a simple model (no outputs are linked to this control panel in the illustration):



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1					Model OK										
2	Year Ending								2001	2002	2003	2004	2005	2006	2007
21															
22	**3.0 Debt Financing**														
23	Funding - debt to total asset ratio								40.0%	DebtRatioIn					
24	Interest rate - senior debt								7.00%	InterestRateIn					
25	Senior debt term (years)							1	20.0	DebtTermIn					
26															
27	20 year annuity repayment							7	8	9	10	11	12	13	14
28	**20 year annuity repayment**							13,480,943.6	-	975,717.0	1,044,017.2	1,117,098.4	1,195,295.3	1,278,966.0	1,368,493.6
29	**10 Year Bullet**							40,000,000.0	-	-	-	-	-	-	-
30	**10 year amortising**							40,000,000.0	-	1,540,910.3	1,849,092.3	2,218,910.8	2,662,693.0	3,195,231.5	3,834,277.9
31	**Blank 1**														
32	**Blank 2**														
34															
35	**4.0 Equity Financing Assumptions (see 7.0 for subscription amount)**														
36	Dividend payout as % of maximum								45.0%	DivPayoutIn					
37	Equity discount rate								13.00%	EquityDiscRateIn					
38															
39	**5.0 Tax Assumptions**														
40	Tax rate								30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
41															
42	**6.0 Valuation Assumptions**														
43	EBITDA exit multiple (x)								7.00	ExitMultipleIn					
44	Growth in perpetuity								3.00%	Growth					
45	Terminal year								2011	TerminalYear					
46	EBITDA/Perpetuity switch							TRUE	☑	EBITDA exit multiple					
47															
48	**7.0 Acquisition Sources and Uses - Financing Inputs**														
49	**Sources**														
50	**Initial Debt Financing**								40,000,000						
51	**Initial Equity Subscription**								60,000,000						
52															

In this case there are relatively few controls as the model is quite simple – there is a scenario selector for the debt structure and a switch to allow the valuation basis to be changed from EBITDA multiple to perpetuity.

5. Workings

The workings (like the outputs) are merely calculations based on the inputs and other workings. Inputs from the input sheet are brought through to the workings sheet using link formulae. Workings are most easily built up on a modular basis and for navigation purposes it is easier if each module is located on a separate sheet. For example, capital expenditure, depreciation and book value calculations are inter-dependent and should, therefore, be together on one sheet.

Some common best practice rules for all components of workings are:

- **Never** use hard-wired (input) numbers within formulae.
  Permitted exceptions are:
  - 1 and 0 – used as flags in IF statements, and for starting row and column counters
  - 100 – if using £ and p, $ and c, € and c, etc.

  - 12 and 7 – there will always be 12 months in a calendar year and 7 days in a week (there are not always 360 or 365 days in a year nor 30 days in a month)
- The rule of two-thirds: if the formula takes up more than 2/3 of the formula bar, then it is too long
  - The worksheet is 256 cells wide and 65,536 cells deep – over 16.7 million cells to play with per sheet
  - Breaking down long formulae into several steps makes them easier to understand and edit
  - Where possible, use logical operators (AND, OR, etc.) rather than nested IF functions
  - Use flags (e.g. for dates, event triggers) where possible to shorten formulae
- Avoid the macho

  The shortest formula is often, though not always, the best. '=MAX(0,D16)' and '=IF(D16<0,0,D16)' do exactly the same thing. However, the first belongs to the macho school of modelling (adopt a clever formula whenever possible), whilst the second is widely understood
- Develop a consistent sign convention across all workings
- Insert notes / comments where it may not be obvious what the logic is (for easy review)
- Do not create circular references; they slow down calculations and may cause Excel to crash
  - Results depend on Excel settings (in the Tools; Options; Calculations menu), i.e., maximum iterations and maximum change
  - Once a circular reference has been created, it is very easy to add further circular references without being aware of it
  - They can always be avoided with more careful formulation or automated goal seeks. However, in the interests of time you may be able to tolerate a circular reference if you close the circularity whilst editing the model (for example by having some sort of switch) (see later)
- Shade areas in different colours for ease of navigation (some sheets may be large)

- Row consistency: where possible, avoid changing formulae across a single row (see F5-Special later)
  - Try to keep to one row / one formula
  - If unavoidable, highlight the non-standard cells
  - A reviewer needs to be confident that there are no hidden fixes in individual cells
- Format consistency: consistent number styles (see Styles later) and sheet set-up (see Sheet consistency later) enables quick interpretation of the results
- Only name those ranges / cells that will be used away from the near vicinity (see Names later).

6. Outputs

Depending on the size of the model, the outputs may be the same as the workings or, more often, a summary of the workings (and inputs). Here, format matters.

- Outputs should require little calculation other than totals
- The most important figures (e.g. debt service coverage, NPV etc.) should be formatted to give them the importance they deserve
- Pictures speak a thousand words – diagrams and charts often clarify the results and flows better than pure numbers
- Text strings may be useful to put the output numbers into meaningful sentences.

Sheet consistency

The more consistent the format (colours, numbers, columns, titles, headings, footers, views, etc.) between sheets, the easier the construction and review. Hence a lot of the formatting of the entire model can (and should) be done up front.

There are two methods to arrive at the same result of consistent formatting throughout the model:

- Group the sheets and format them all together; or
- Set up one sheet and then copy it the requisite number of times.

The first method could be dangerous as data on other sheets may be overwritten, whilst the second method is slightly more fiddly when trying to get the correct number of properly named sheets. When used with the care, the first group edit option is the more straightforward.

The steps

1. Assess how many sheets are needed (and add one – it can always be removed). New sheets can be added by right clicking a sheet tab, choosing Insert and Worksheet or pressing Shift + F11
    - The easiest way is to name each sheet that you think you will need
    - Use abbreviated sheet names – the shortest name that is understandable
        - It is very useful to be able to see all of the sheet tabs at once
        - Short sheet names make shorter cell addresses when used across sheets – making formulae shorter and easier to interpret.
2. Select all sheets to do consistent formatting (to set up group editing)
    - Control+Shift+Page Down; or

      Right mouse on a sheet tab – Select All Sheets.
3. Size the columns
    - Column A (small); Column B (small); Column C (big)
        - Natural indents for ease of reading text / headings
        - To allow sufficient "space" should it be needed
    - Column D (very small)
        - For check digits
        - Allows the data to be selected more efficiently if there is a natural break
        - Makes naming ranges easier
        - Enables creation of consistent formulae on corkscrews
    - Put in all the years (and currency) - i.e. column headings
        - Column E is the 1st period and then copy the sequence across all relevant columns

- Only if a period (e.g. y/e31/8/07) is in the same column in every sheet throughout the model can the range name tool be used effectively

- Leave a blank column at the end of the final period (make it small)
  - Allows easy insertion of further periods if they are subsequently needed
  - Allows the data to be selected more efficiently if there is a natural break

  The final column after the blank will be used for recording range names.

4. Fit the spreadsheet to the appropriate size
   - Highlight the next column (after the range names column); and then
   - Control+Shift+® (selects the remaining columns on the sheet);
   - Format; Column; Hide or right mouse followed by H or Control+) (hides all the highlighted columns). To restore the hidden columns Control+Shift+) or Format; Column; Unhide.
5. Formatting numbers and text (see Formatting later) – if Styles are to be used, then this can be done following the group edit phase.
6. Print set-up (so it is ready to go from the start). If the sheets have been grouped together and you use the File; Page; Setup command, the settings you specify will apply to all sheets in the group. If, however, you run File; Print Preview and run the Setup command from there, the settings only apply to the current sheet, whether or not it is one of a group
   - Fit to page. Landscape orientation is often chosen. If a standard layout has been adopted, all sheets will be a constant width but the length will differ. Page Setup offers a percentage value, or to fit to a specified number of pages. Rather than specifying 1 page wide by 1 page tall, the width requirement is entered and the height is left blank
   - Default margins are often too large and need to be adjusted
   - Headers & footers to include file name (and location if using Excel 2003); sheet name; date and time; and page of page ([Page] of &[Pages]). At times more information needs to be entered than the header / footer codes provide. In a worksheet, functions such as =CELL("filename",A1) will return the full path of the spreadsheet rather than the simple file name returned by the &[file] code used in the header / footer dialogue box

- Print titles (probably the periods) – will have to be done outside of the group edit as they are worksheet specific
- Remove the gridlines.

Once setup is complete Print Preview should be reviewed.

Using and managing windows in Excel

Using more than one window

When reviewing a model it is often useful to be able to see two parts of the model simultaneously.

This can be achieved by opening a second window and viewing both of them at the same time. In this way, whilst making changes in one part of the model, the impact of those changes in a completely different and, possibly, distant part of the model can be seen.

With the current model visible:

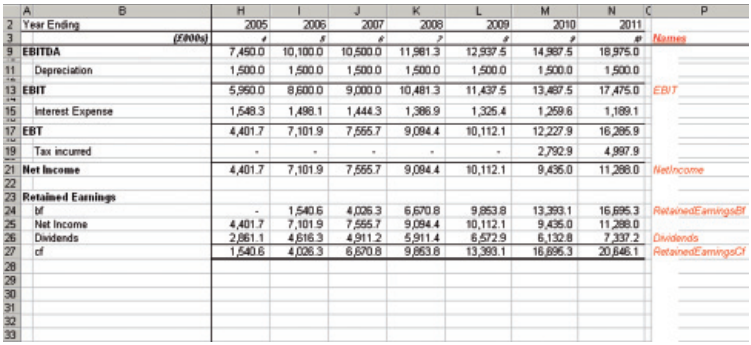
- Select Window; New Window – there are now two windows open, both looking onto the same file – Filename.xls:1 and Filename.xls:2
- To see them simultaneously, select Window; Arrange; Horizontal (or vertical or cascade) and ensure 'Windows of active workbook' is checked.

Amending either window will update the model in the normal way.
When two windows are no longer required, one of them (preferably the new window opened) can be closed and the original version will still be open.

Switching between windows is very straightforward: through the Window menu by selecting the relevant window from the list, or by using the shortcuts Ctrl+F6 or Ctrl+Tab. Using this shortcut repeatedly moves consecutively from one window to another window.

Freezing panes

The Window Freeze Panes command "freezes" the rows and columns above and to the right of the selected cells. This is very useful as it results in the row and column titles always being visible on the screen.



	A	B	H	I	J	K	L	M	N	C	P
2	Year Ending		2005	2006	2007	2008	2009	2010	2011		
3		(£'000s)	e	f	g	h	i	j	k		Names
9	**EBITDA**		7,450.0	10,100.0	10,500.0	11,981.3	12,937.5	14,987.5	18,975.0		
11		Depreciation	1,500.0	1,500.0	1,500.0	1,500.0	1,500.0	1,500.0	1,500.0		
13	**EBIT**		5,950.0	8,600.0	9,000.0	10,481.3	11,437.5	13,487.5	17,475.0		EBIT
15		Interest Expense	1,548.3	1,498.1	1,444.3	1,386.9	1,325.4	1,259.6	1,189.1		
17	**EBT**		4,401.7	7,101.9	7,555.7	9,094.4	10,112.1	12,227.9	16,285.9		
19		Tax incurred	-	-	-	-	-	2,792.9	4,997.9		
21	**Net Income**		4,401.7	7,101.9	7,555.7	9,094.4	10,112.1	9,435.0	11,288.0		NetIncome
22											
23	**Retained Earnings**										
24		bf	-	1,540.6	4,026.3	6,670.8	9,853.8	13,393.1	16,695.3		RetainedEarningsBf
25		Net Income	4,401.7	7,101.9	7,555.7	9,094.4	10,112.1	9,435.0	11,288.0		
26		Dividends	2,861.1	4,616.3	4,911.2	5,911.4	6,572.9	6,132.8	7,337.2		Dividends
27		cf	1,540.6	4,026.3	6,670.8	9,853.8	13,393.1	16,695.3	20,646.1		RetainedEarningsCf
28											
29											
30											
31											
32											
33											

In this case, the freeze panes command was used in cell C4.

Referencing

Relative vs. absolute references

Excel calculates in terms of the relative position of an item – i.e. cell C4 is 3 columns and 4 rows into the sheet. Fortunately, to ease interpretation, the references in Excel use the column letter and row number address (i.e. C4).

	A	B	C	D	E
1	147	852	654		
2	741	951	357		
3	753	258	456		
4					
5					
6					
7					

If we placed the formula '=A1' in cell C4 this is interpreted by Excel as entering the value from 3 cells above and 2 columns to the left, i.e. 147 from cell A1 in the above spreadsheet.

If we copy the formula in C4 to:

- D4, we are still trying to pick up the value from 3 cells above and 2 columns to the left (of D4 this time) – i.e. 852 from B1
- C6, we are still trying to pick up the value from 3 cells above and 2 columns to the left (of C6 this time) – i.e. 753 from A3.

By default Excel works in this relative way.

F4 – absolute referencing

'Dollarising' the cell reference in a formula (press F4 whilst the cell reference is input or edited) will add dollars to a reference. If we placed the formula "=$A$1" in cell C4 this fixes the address as always column A and always row 1. This is still interpreted by Excel as the 147 from cell A1.

However, if we copy the formula in C4 to:

- D4, we are still trying to pick up the value from column A and row 1 – i.e. 147

- C6, we are still trying to pick up the value from column A and row 1 – i.e. 147.

Alternatively we can partly dollarise or fix the reference. When entering or editing a formula, pressing F4 repeatedly will toggle through the fixing options.

- $A1 fixes the column A with the row number remaining relative
- A$1 fixes the row 1 with the column remaining relative.

A rule of thumb: when trying to fix a reference to a cell which is

- To the side of the formula – the $ is to the side
- Above or below the formula – the $ is in the middle.

Naming (cells & ranges)

Cells and ranges can be named – that is, they can be referenced in terms of a name rather than its column and row position within the model.

A name may only be defined once per sheet – i.e. the name relates to a unique cell or range on that sheet. However, the same name can be defined across different sheets, e.g. 3 different cells named TaxRate can be created as cell E30 on Sheet 1; as E45 on Sheet 2; and as F10 on Sheet 5.

F3 is the function key which triggers most of the functionality, i.e. the third function key. This implies that Microsoft believes that the use of names is the third most important function to the smooth running of Excel, behind only Help and formula editing (F1 and F2 respectively).

Why name?

1. Clarity and speed

Using the F4 dollarising option is quick and widely understood and so has its advantages. However, where the cell or cell-range is to be used in calculations:

- On a number of occasions
- At a distance from where it is situated
- On different sheets
- In different models
- As part of a complex formula or function
- Within a macro.

Then naming the cell or cell-range is a better solution. Applying a name to a cell or range can make model construction and review quicker and easier.

2. Auditing

As will be covered later, all the auditing tools work in exactly the same way for both cell references and names. However, if names are used then additional auditing approaches can be introduced.

3. Functionality

Additionally, Excel was created with the intention that names would be used. Consequently, some functions require the use of names, particularly across sheets (e.g. conditional formatting and data validation).

4. Geographic precisions

Some modellers prefer the geographic precision of the cell reference. There is no dispute over Inputs!D2. However, most of the time, it is what the cell contains rather than where it is, that is more important.

Creating names

There are a number of ways to name cells or ranges. The following are the two most widely used.

1. Insert; Name; Create

The Name Create command uses labels at the end of a range, or beside a cell, to name the range or cell respectively. By using this standard referencing approach and formatting these labels (red, italic) the named cells and ranges are clearly identified.

This can be automated:

1. Type the name to the right of the cell or range to be named
2. Highlight the cell containing the name that has just been typed in
3. Control+Shift+¬ this will highlight all the cells, which may just be one, with contents to the left which require naming
4. Control+Shift+F3 – should see the following dialogue box:

5. Check the Right column box (Excel may have already checked it)
6. Press Return.

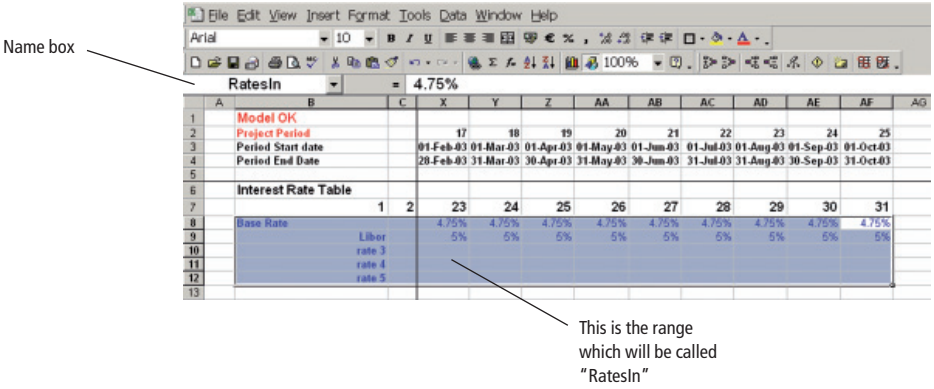
The real value of this function is that all of the row ranges in a sheet can be named simultaneously by highlighting all required ranges or cells and the cells containing their names and then following the above steps.

If the name is typed to the Right of the cell or range, ensure only Right column is checked.

2. Quick and dirty

1. Highlight the range or cell to be named
2. Click in the name box at the top left
3. Type in the name (with no spaces)
4. Press Return.

To check the name just click on the down arrow by the name box and the names which have been defined in the model will be listed.



The Ctrl+Shift+F3 method has a formality to the method (so reducing modelling errors) and visibly identifies the named cells and ranges immediately to the right (so helping use and review). However it cannot be used for two-dimensional ranges, which is where this second method proves useful.

Changing or "stretching" a range which has already got a name

Where a row of data for a number of periods is to be named, leave a blank cell between the data and the name and follow the Ctrl+Shift+F3 naming procedure. This allows additional periods to be added (as per best practice model set-up procedures) with the named range automatically extending as new periods are inserted.

However, it is not unusual to want to extend a range after it has already been created. If the above has not been done or a two-dimensional data range is to be changed, the only practical way to do this, without deleting the name and recreating it, is as follows:

- Insert; Name; Define (or Ctrl+F3)
- Select the name from the list which you want to attach to the new or stretched range
- Press the browse button . Excel will display and highlight the range that is attached to the name. Now click and drag to highlight the new range you want to attach. Press the finish selection button , you will now return to the Define Name dialogue box
- Click on the Add button. This overwrites the old definition of the name and range with the new one you have just selected.

Using names

Names can be used in formulae in the same way as other references. To use a name in a formula:

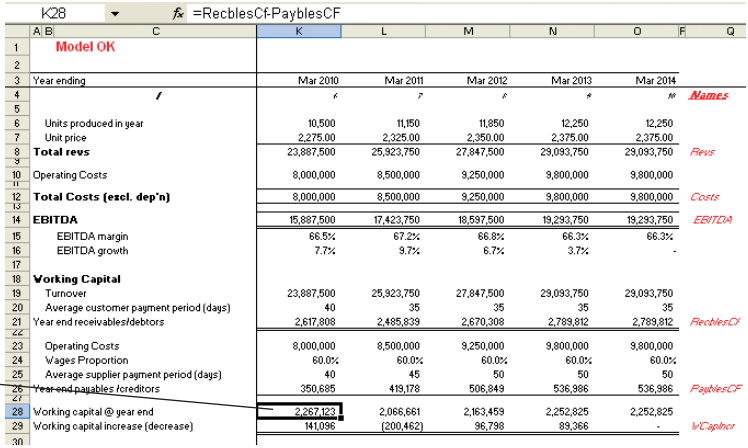
- Click on the named cell; or
- Type in the name (it is not case sensitive); or
- Press F3 and the names listed alphabetically will be available for selection. As the list of names can be quite long, the few letters of the name can be typed in to enable more rapid scrolling through the list.

When a cell name is used, it is used as an absolute reference – as if it were fully dollarised.

When a range name relating to a row of data is used in a particular cell, the data, within the range which is in the same column as the particular cell, will be returned.

For example, if the range named "Sales" is defined on Sheet1 as E6:N6 and if the formula in cell G72 on any sheet is "=Sales", the value returned will be that from column G in the named range (i.e. cell G6 on Sheet1). If the formula is in a cell which does not have a corresponding name in the same column, the result is #VALUE.

A typical spreadsheet will look like this (Note, only those ranges which will be used extensively elsewhere on the model have been named):



K28 =RecblesCf-PayblesCF

	A	B	C	K	L	M	N	O	P	Q
1			Model OK							
2										
3			Year ending	Mar 2010	Mar 2011	Mar 2012	Mar 2013	Mar 2014		
4				1	2	3	4	5		Names
5										
6			Units produced in year	10,500	11,150	11,850	12,250	12,250		
7			Unit price	2,275.00	2,325.00	2,350.00	2,375.00	2,375.00		
8			**Total revs**	23,887,500	25,923,750	27,847,500	29,093,750	29,093,750		Revs
9										
10			Operating Costs	8,000,000	8,500,000	9,250,000	9,800,000	9,800,000		
11										
12			**Total Costs (excl. dep'n)**	8,000,000	8,500,000	9,250,000	9,800,000	9,800,000		Costs
13										
14			**EBITDA**	15,887,500	17,423,750	18,597,500	19,293,750	19,293,750		EBITDA
15			EBITDA margin	66.5%	67.2%	66.8%	66.3%	66.3%		
16			EBITDA growth	7.7%	9.7%	6.7%	3.7%	-		
17										
18			**Working Capital**							
19			Turnover	23,887,500	25,923,750	27,847,500	29,093,750	29,093,750		
20			Average customer payment period (days)	40	35	35	35	35		
21			Year end receivables/debtors	2,617,808	2,485,839	2,670,308	2,789,812	2,789,812		RecblesCf
22										
23			Operating Costs	8,000,000	8,500,000	9,250,000	9,800,000	9,800,000		
24			Wages Proportion	60.0%	60.0%	60.0%	60.0%	60.0%		
25			Average supplier payment period (days)	40	45	50	50	50		
26			Year end payables /creditors	350,685	419,178	506,849	536,986	536,986		PayblesCF
27										
28			Working capital @ year end	2,267,123	2,066,661	2,163,459	2,252,825	2,252,825		
29			Working capital increase (decrease)	141,096	(200,462)	96,798	89,366	-		WCapIncr
30										

Cell K28 is easy to review due to the use of names

Pasting the list of names

This feature is used to create a checklist of all the names and the number of names used within the model by listing the names and their location.

Select the place where the first name is to be listed and then

- Insert; Name; Paste; Paste List; or
- F3, Paste List.

The names will be in the first column and the location will be in the next column.

Applying names

It is undoubtedly quicker to write some formulae using cell references and it would be laborious to then rewrite the formula using the appropriate names. Instead, the Insert; Name; Apply commands can be used. Excel will scan through the worksheet and identify any cell references that correspond to named ranges and convert the reference to the name. When using this command, Excel has automatically selected one or more names. This is because Excel remembers the last names that have been created.

Deleting names

Good practice suggests that misspelled or redundant names should be deleted at the earliest opportunity. Insert; Name; Define (Control+F3) is the only way to delete range names.

If the deleted name has already been used in a formula the #NAME? error value appears. To correct this problem use Edit; Replace (Control+H) to substitute a new or corrected name for the deleted name.

When to use a name

Naming rules

Do not name everything

Despite all the advantages of naming cells and ranges, too many names cloud the model (a list of 237 names is not easy to use or review).

Only name those cells or ranges which will be used extensively and at some distance from their current location – be systematic but not out of control.

Range names – all sheets must be consistent

If rows of data are named, Excel interprets the reference in subsequent formulae in relation to the columns. As seen, if the range named "Sales" is defined on Sheet1 as E6:N6 and if the formula in cell G72 on any sheet is "=Sales", the value in this cell will be that from column G in the named range (i.e. cell G6 on Sheet1).

Where range names are used, all sheets must be consistent – column G in the source sheet must relate to the same time period, for example, as on the target sheet.

If new columns are to be added on any sheet, then they must be added to all sheets in order to allow named ranges to be used.

Range name stretching

If ranges are named the area that is used must be chosen so that the named range can be easily expanded. By adding a spare column and / or row at the end of the data and incorporating those blank cells within the named area, it is easy to add rows and / or columns to the named range.

Naming conventions

- The name labels should be formatted as Red and Italic and should lie directly to the right of the cell or range to which it relates
- The shorter the name the better – as long as it is understandable to the user and reviewer
- Avoid spaces – Excel will interpret these as "_" making unwieldy names such as Costs_gas_in rather than the more refined CostsGasIn (i.e. capital letters can be used to separate words instead)
- CostsGas, PriceGas, DepnTax, etc. – i.e. begin name by category or by most important word first for ease of use later
- CostsTot is better than TotCosts – otherwise searching for total costs may require trawling through 30 names in the list starting with total
- WkCapIncr is better than WkCapChange – it is easier to understand the sign convention: a positive number must be an increase
- Those on the inputs page should end with "In", e.g. CostsGasIn, PriceGasIn, etc. for ease of review
- Names must be unique. If a name is created that already exists on the same sheet Excel will prompt and offer the choice of going ahead with a new name and eliminating the earlier definition or to stop and set up an alternative name for the current range.

Do not over-engineer

A name should be used in a formula when it is helpful and not too onerous to do so.

- For example, if sales is calculated as a function of three names and EBITDA is calculated as a (named) percentage of sales, it would be over-engineered

to calculate the EBITDA based on four names rather than the more straightforward named percentage × (the previously calculated) sales.

Subtotals on workings and outputs can be calculated in two ways – by reference to a (possibly named) cell elsewhere in the model or by summing the nearby cells.

The latter method is the preferred route as this checks that the current region is populated with only appropriate values – particularly important on outputs.

- For example, if EBITDA has been calculated in a working (as above) and is then used as part of the income statement – the EBITDA on the income statement should be re-calculated using the details on the income statement (sales less costs) rather than referred back to the original working.

The MAX MIN issue

When the MAX and MIN functions are being used with named ranges, the maximum (or minimum) number in the range is returned rather than those relative to the column in which we are interested. This is avoided by including a + sign in front of the named range when coding the formula. For example:

=MAX(+PAT,+RetainedProfits)

Copying to other models

As long as the inputs to the tax sheet, for example, are defined in the destination model (i.e. using the same names) then the tax workings sheet can be easily inserted into the destination model.

- Click right mouse button on the tax sheet's tab in the source model
- Move or Copy
- Define the destination model
- Check the copy box.

This can be useful, but can also cause problems if there is not complete rigour in naming – the more rigour incorporated in naming and model set-up, the easier the copying of modules between models.

Transpose

Occasionally numbers appear horizontally in a row when it would be useful to have them vertically in a column or vice versa.

If these are numbers (rather than formulae), then the solution is straightforward:

- Copy the relevant range
- Go to the first of the cells where the range is to be copied to
- Edit, Paste Special, Transpose.

The transpose function can be combined with other functions in paste special.

More likely, the range to be transposed is made up of formulae.
The paste special transpose will only be suitable if all formulae contain only constants and absolute references (i.e. named cells or cells of the type $D$4).
Where more complex formulae exist which have relative references, the TRANSPOSE function can be used.

For example, it would be useful to show the formulae from the range D3:J3 vertically in D10:D16:

- Count the numbers of cells in the range to be copied (7)
- Select the cells in the range to be copied to (D10:D16)
- Type: =TRANSPOSE(D3:J3)
- Press Control+Shift+Enter.

By pressing Control+Shift+Enter, an array has been created (as shown by the { } around the equation). Deleting the whole array rather than any one individual cell is the only way to modify this.

Formatting

Some formats and formatting conventions (for example, outputs) will be pre-defined to adhere to corporate templates which will have their own logic. The more logical and consistent all formats, the easier the model is to use and review.

Sign convention

Choose a sign convention, stick with it and explain it.

Negatives are difficult to work with and it may be easier to avoid them. All inputs and workings should therefore be positive, unless they are unusual.

> For example, interest in the income statement is mostly an expense but should be entered and calculated as a positive. To ensure that this is clearly understood it is necessary to describe the line as "Net interest expense (income)". In this way, the user of the model understands that a positive number refers to an expense whilst a negative implies net interest income.

The downside to this is that users misunderstand the sign convention (through not reading the description carefully) and the simple =Sum() calculations may not be possible. The major advantage is that the logic of the model is uncluttered by thoughts of sign convention – everything is positive.

The exceptions

- Outputs

  This may be governed by the corporate style rules. Ordinarily the sign convention on the outputs is the one which is most easily understood by the reviewer. If it is easier to understand an income statement if expenses are negatives, then expenses should be negatives.

- Specifics

  Some workings, for example cash flows, may be easier to work with if the sign convention follows the cash flows. An increase in working capital will reduce cash flow – trying to explain this in words as "Decrease (increase) in working capital" may prove cumbersome whereas having the increase as a negative (and all other cash flows following this convention) is likely to be easier.

Colours, size and number formats

Text & data

Feature	Setting	Justification
Size	Default – probably 8 point Change the view settings if this is too small on the screen Anything smaller than 8 point will default to Times New Roman when pasted into other applications	If elements are to be pasted into other applications such as PowerPoint, it is easier to expand than contract the selection once it is in PowerPoint. For example, a sheet using 14 point when pasted into PowerPoint may miss some data. When using 8 point, more data can be trapped (and dragged to expand if needed)
Inputs	Blue text, pale yellow background and underlined	To stand out – underlining stands out even if printed in black and white
Names	Red and italic	To stand out
Workings sheets	Different backgrounds to highlight different sections and summaries	To help navigation
Totals, sub-totals	Bold, italic, borders – use sparingly	Used to emphasise
Headings & outputs	To highlight key rows, columns and cells	Format is a personal / corporate decision
Everything else	Default settings	So that all outputs and inputs stand out

Other conventions

- Inputs – always blue, but can differentiate further, e.g. yellow background for our inputs; grey background for client-sourced inputs; green background for formulae used to help create inputs, but which can be overwritten
- Change of formulae across a row – rarely needed, but highlight with a format change e.g. a boxed cell or pink cell
- Links – often green font is used for links between sheets; grey font if linked externally.

Numbers

Number	Format	Comments
Decimal points & commas	12,345.6	Align with negatives
Negatives	(12,345.6)	Bracket (parenthesis) stands out more than a minus sign
Zeros	–	Stands out more in a list of figures than 0.0 Unfortunately, rounding errors will still appear as 0.0 which may be misleading
Thousands & millions	May take out the 000s and millions	In the *outputs* only

Formatting numbers

To format the numbers:

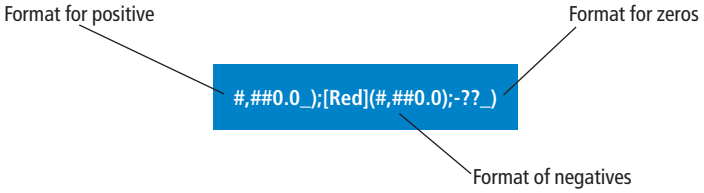
- Select the range to be formatted
- Format; Cells; Custom; or
- Control-1; Custom and press Alt-T into the type box.

The sections, separated by semi-colons, define the formats (in order) for:

1. Positive numbers
2. Negative numbers
3. Zero values
4. Text.

If you specify less than 4 sections then the text will have a standard format.

e.g.



displays only significant digits; does not display insignificant zeros.

0 displays insignificant zeros if a number has fewer digits than there are zeros in the format. [the above would show 1234.56 as 1,234.6; .123456 as 0.1; and 0.0 as -]

, adds a comma to separate 000s.

Additionally, it can scale a number by a multiple of one thousand (useful for the output sheets)

e.g. 1234567890 as 1,234,567,890.0 #,##0.0

1234567890 as 1,234,567.9 #,##0.0,

1234567890 as 1,234.6 #,##0.0,,

1234567890 as 1,234.6m #,##0.0,,"m"

_ aligns the numbers with the character following the underscore. For example, when an underscore is followed by a closing parenthesis " _)", positive numbers line up correctly with negative numbers that are enclosed in parentheses.

? adds a space a character wide, used to indent (normally from the right)

* put at the front, a format will add the next character to fill the cell.

e.g. 123 as -------123.0 *-0.0

[Red] also available in black, blue, cyan, green, magenta, white and yellow. Only used for outputs as may undermine default colour conventions.

(See later for date formats.)

Numbers (with text for presentation)

Sometimes it is useful for a number to be followed by the units, e.g. p, years, cents, x.

For example, if an input in a model is the number of years on which a valuation is to be based, the number of years can be entered, say 7, and it will appear in the cell as '7 years'.

As before, select the area to be formatted, Control+1; Custom, choose the number format (e.g. 0) and then leave a space followed by "years" – i.e.

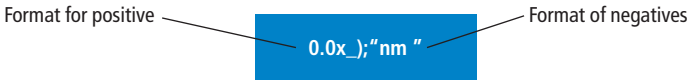
0 "years"

Combined with knowledge of other number formatting rules, this can be very useful as custom formatting can be used as a basic type of conditional formatting.

For example, if a company has a price per share of 36.50 and an earnings per share of –1.25 and 3.30 in year 1 and 2 respectively, its P/E ratio (price ÷ earnings) can be easily calculated.

The results are –29.2 and 11.0606 for years 1 and 2 respectively. The result in year 2 should appear as 11.1x (format "0.0x"), whilst that for year 1 is not meaningful or "nm" – all negative results from such an equation are not meaningful.

Armed with this the following number format can be applied to the P/E cells:



Note that the "nm " has a space at the end to align it with the positive.

White text

It will often be necessary to use white text where certain cells are not to be part of the presentation. Not only can this be done using conditional formatting, where data is to be hidden on the output pages if certain conditions are fulfilled (i.e. through conditional formatting), but also there will be cells used as counters (maybe linked to switches or as part of VLOOKUP or INDEX) which you do not want to be part of any presentation. For these cells select the white font.

The main problem now is that with a white background, these cells cannot be seen. It is therefore recommended that the background be altered to grey: – see Excel set-up earlier in the notes.

Styles

The use of styles within Excel, as within Word, enables quick and easy changing of all the formats within the whole model. Headings, dates, subtotals, percentages and others can be selected (and globally modified) quickly.

At set-up it is worth defining the styles (i.e. the formats) that may be used in the current model – consequently, formatting need only be done once and then quickly and easily applied elsewhere.

For example, it is often worth having the font size as 8 pt for easy transfer to presentations. By defining styles up front the default can be changed for the whole model.

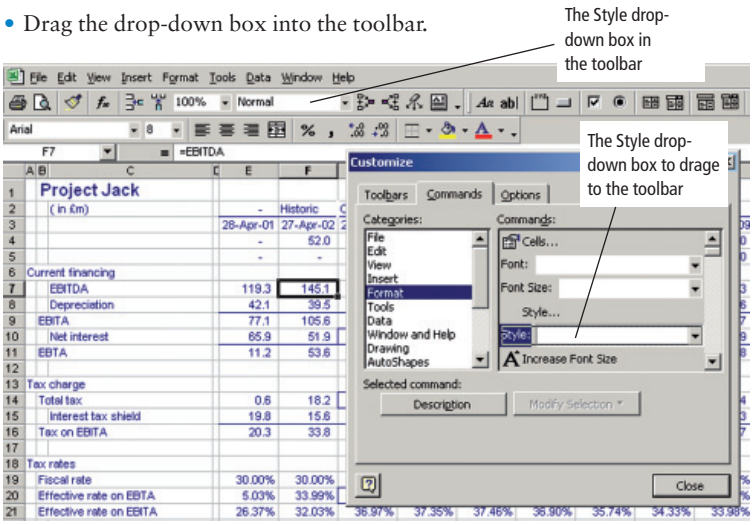
As within Word, to apply a defined style – use the styles drop-down box for the selected cell(s).

Adding styles to the toolbar

In order to use styles efficiently, add the styles drop-down box to the toolbar – the style in use will then be listed.

The Styles drop-down box can be added by:

- Tools; Customize; Commands – The Style drop-down box is part of the Formats category
- Drag the drop-down box into the toolbar.



Once the drop-down box has been placed in the toolbar it can be accessed by

Alt ‘

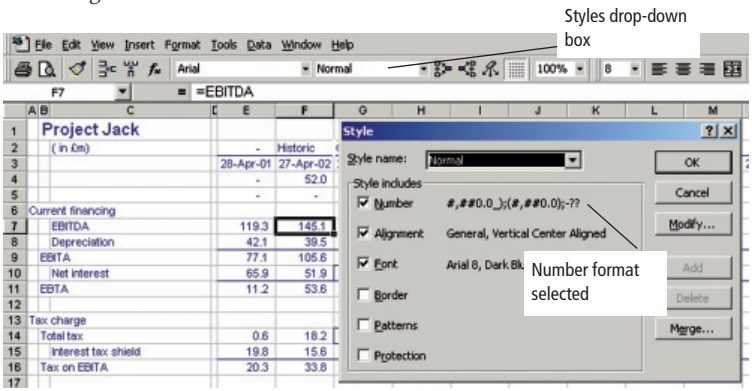
followed by Alt + either the up or down arrow key to scroll through the styles.

To change / add a style

The Comma, Currency and Percent styles exist by default in Excel to support the corresponding toolbar buttons and should not be deleted. Additionally, the default setting for all cells is Normal.

1. To change, for example, Normal:
   - Format; Style – Normal should appear in the Style name box
   - Modify – after which the normal Format Cells dialogue box appears
   - Format, as required, the
     - Number format (e.g. #,##0.0_);(#,##0.0);-_)
     - Alignment (e.g. vertically Center (sic) Aligned)
     - Font (e.g. Automatic, Arial 8)
   - Select Add and then OK.

   The formats of all (previously unformatted) cells within the model will change to this new default normal.



2. If you wish to create a format, e.g. dates, to be used as a standard to be applied elsewhere:
   - Format; Style
   - In the Style name box, type a name for the new style – e.g. "Dates" (without the quotation marks)
   - Modify

- On any of the tabs in the dialogue box, select the formats you want, and then click OK – e.g. number to custom "dd-mmm-yy" (without the quotation marks) etc.
- To define and apply the style to the selected cells, click OK
- To define the style but not apply it to the selected cell, click Add, and then click Close.

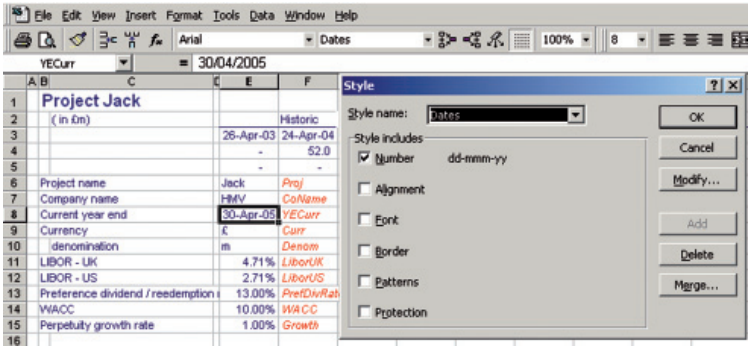
3. If you wish to choose the format of a particular, previously formatted, cell, e.g. a multiple, as a standard to be applied elsewhere:
   - Select the cell containing the required format
   - In the Style drop down box type in the name – e.g. "Multiple" – and press Enter.

   Alternatively:
   - Format; Style
   - In the Style name box, type a name for the new style – e.g. "Multiple" (without the quotation marks)
   - To define the style, click Add, and then click Close.

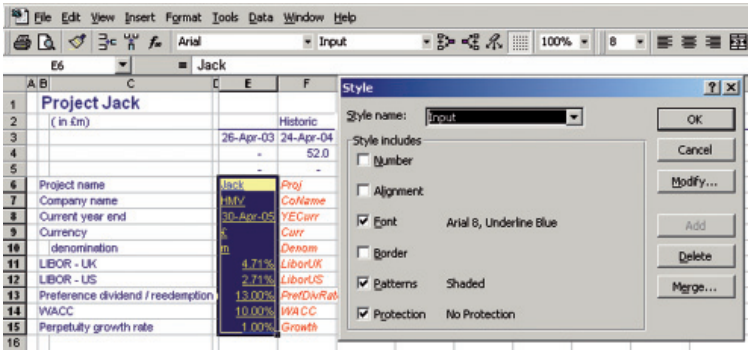
To check the boxes or not

A cell can have more than one style applied to it. As a result, a cell may have the Dates style applied and then another style laid on top – where there are any conflicts in styles the second style will take precedence.

For example in the following, the Dates style has been defined using only Number format. All other Cell formats in the Dates style have not been defined. Cells E3, F3 and E8 have this format.



Input cells should be differentiated from calculation cells by format (and protection) and so an input style should be defined. As there are likely to be a number of different input types it is useful to have the common features of an input style superimposed onto other styles. For example, cell E8 is both a date and input:



As the number format in the Input style is not defined it will follow the previously selected number format for all cells. The components of the Input style which are applied are:

- Font – Underlined, Blue
- Patterns – Pale yellow background
- Protection – No protection.

As the Date and Input styles do not conflict, cell E8 therefore has both styles applied.

Copy styles from another workbook

Once the time has been taken to define a set of styles in a model, these can be used as the template for future models.

- Open the model that contains the styles to be copied
- Open the model in which the styles are to be inserted, and then click Style on the Format menu
- Merge
- Double-click the workbook that contains the styles to be copied.

To replace the styles in the active workbook with the copied styles, click Yes. To keep the styles in the active workbook, click No. This warning occurs only once, regardless of the number of conflicting style names.

Colour

Note: the colour template used on the source document may be different to that in the destination file – so that when styles are merged, the text, borders and background colours are not as required. To apply the colours from the source document, ensure that both models are open and in the destination model:

- Tools, Options, Color
- In the "Copy colors from" box select the workbook that contains the colours to be copied
- OK.

In this way a template model with all necessary styles and colours can be easily created (and updated) for quick merging into all future models.

Conditional formatting

Conditional formatting applies a defined format to cells which fulfil a condition.

To conditionally format the numbers (for example, where a negative result should not be possible, or should be flagged, or where a balance sheet does not balance)

- Select the range to which the conditional formatting will apply
- Format; Conditional Formatting.

The more obvious the formatting (size, colour etc.) the more useful the result.

There are two condition (logical argument) options:

- Cell Value Is — the value of the current cell fulfils the criteria
- Formula Is — the result of the formula (which may not refer to the current cell) fulfils the criteria.

Note the format chosen is only applied when the condition is true.

When using multiple conditions it is important to get the sequence right:

- Cell value less than 10 Blue

- Cell value less than 100 Green
- Cell value less than 1,000 Red.

This sequence gives expected results.

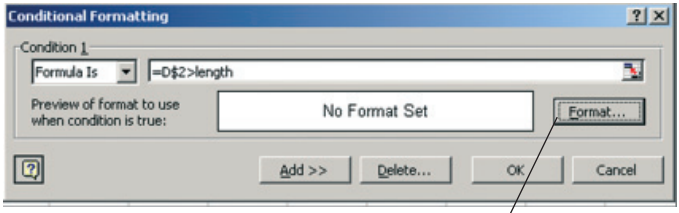
- Cell value less than 1,000 Red
- Cell value less than 100 Green
- Cell value less than 10 Blue.

This sequence gives unexpected results – any value below 1,000 is coloured red and the subsequent criteria are not applied.

Conditional formatting to hide cells

There will be occasions where it will be useful for cells to be hidden. For example, if a discounted cash flow (DCF) valuation model has been set up for a maximum of 10 years, but 7 years has been input as the project length (named "length"), from a presentation perspective, it would be good to hide the 3 years which are now not part of the output. (It is assumed that there is appropriate coding to calculate the valuation based on 7 years!).

If the year counters are in row 2 with column D containing the first period, go to Format; Conditional Formatting; enter the appropriate formula (essentially the logical test of an IF statement); then choose Format and select white font and no borders from the menus.



To have white text on a white background, you will have to click on the Format button and change the font colour to white. Also click on the Borders tab and click on the "No borders button"

Text strings

Text strings allow phrases, sentences, labels and headings within a model to be automatically updated for changes in assumptions or outputs.
For example, it may be useful to have a standard header in B2 with the company name (Bigco defined in cell E5) and currency (€m defined in cell E6) – both of which are inputs which may change.

The ampersand [&] is the key to linking different bits of text: The formula in B2

=E5&" in "&E6 results in Bigco in €m

In the above example, there are three bits of text (the company name, the word "in" with spaces around it and the currency) each connected using the ampersand.

The TEXT function

Text and numbers which use the default format settings can be linked with the use of the ampersand. However, where numbers form part of the text string, they may need to be formatted. This is when the TEXT function needs to be added to the text string.

For instance, a model may be titled "Year ended 31 December 2006". Assumptions within the model may change the year-end which has been defined in cell G4. Without a text string, whenever the date in G4 changes the model will have to be updated cell by cell, a tedious task!

Alternatively, the text can be coded as:

="Year ended "&TEXT(G4,"dd mmmm yyyy").

The TEXT function picks up cell G4 (assumed to contain the year-end information) and then formats the number contained within this cell into the date format dd mmmm yyyy (which must be put within quotation marks).

Similar things can be done for multiples [=TEXT(G6,"0.0x;"nm "")] and percentages [=TEXT(G7,"0.0%;(0.0%)")] etc. Note that where more than one format is to be chosen in a TEXT function (for positives and negatives), they must be separated by a semi-colon within the format text part of the function.

Regional settings

To change / view the profile for regional settings:

> Start; Settings; Control Panel; Regional and language options; Regional options

This is a profile setting rather than merely an Excel setting – it has applicability across all applications.

Often there are company policies on regional settings – all staff in all locations have the same regional setting, e.g. English (United States). However, it may be useful from time to time to alter this for local language, currency and formatting idiosyncrasies.

Where a cell is formatted using the number formats and the users regional settings are English (United Kingdom) then the language (d for day, m for month, etc.) and settings (e.g. commas as thousand dividers, etc.) will be used. If the model is then passed onto someone with a French (France) regional setting, then the language (j for day, m for month, etc.) and settings (space as thousand dividers, etc.) will automatically update even if formats have been customised.

However, the regional settings do not update the formats contained within a TEXT function. The result is that Excel is unable to interpret the TEXT function. Care must be taken when using the TEXT function if it is likely that a model will be accessed by users with different regional settings.

IF and some other logical functions

When writing functions into the spreadsheet it can be difficult to remember the sequence of arguments. Shift+F3 can be used to bring up the paste function dialogue box or Control+A brings up the function window once the function name has been typed.

A fundamental function to add flexibility to models is the IF statement. IF can most simply be thought of as a switch. Excel carries out a test and depending on the result chooses between two answers, TRUE and FALSE.

The syntax of an IF statement is as follows:

> =IF(logical_test,value_if_true,value_if_false)

Excel evaluates the test and if it is true it returns the value_if_true, otherwise it returns the value_if_false. The following extract shows a simple example:

D53 = =IF(D48>3.5,"In breach of covenant","OK")

	B	D	E	F
1		2001£m	2000£m	1999£m
2	**Classical cashflow analysis of ICI**			
43	**2.0 ICI EBITDA based ratios**			
44	EBITDA/Sales	12.2%	10.9%	10.5%
45	Continued EBITDA/Continued sales	11.0%	11.1%	10.8%
46	Continued EBITDA/Interest	3.4	3.1	2.2
47	EBITDA/Interest	3.8	3.7	2.9
48	Net Debt/EBITDA	3.7	3.3	2.6
49	Net Debt/(continuing EBITDA)	4.1	3.9	3.5
50	EV/EBITDA	6.8	7.7	6.6
51	EV/Continuing EBITDA)	7.5	9.1	8.8
52	EV/Sales	83%	83%	70%
53		In breach of covenant	OK	OK
54				

The formula in the formula bar at the top has been copied across the row: The result of D48 is greater than 3.5 and so the result of the test is TRUE: Excel therefore returns "in breach of covenant". The ratio in E48 is less than 3.5, and so the result of the test is FALSE. Excel therefore chooses the value_if_false, i.e. "OK".

Logical test

Any formula or cell result which yields TRUE or FALSE is a test. When the test is in the form of a formula, Excel evaluates it and produces the result TRUE or FALSE.

There are a number of "operators" that can be used to create different logical tests:

- = Equals
- > Greater than
- < Less than
- >= Greater than or equal to
- <= Less than or equal to
- <> Not equal to

Excel is capable of evaluating logical statements. Try typing in =1=2 and look at the result: the result is FALSE.

The words TRUE and FALSE in Excel have a special status, in that Excel understands them in the same way that it understands a number or a formula. Excel also understands TRUE as the number 1 and FALSE as

a zero. In the above =1=2 equation, the result of this cell could either be regarded as FALSE or 0 for further calculations.

If the formula is rewritten:

=(1=2)+0

Excel will return a 0, 0 is FALSE (1 being TRUE). The addition of the zero forces Excel to return the value of the logical operator.

Value arguments

The arguments value_if_true and value_if_false can be given any of a number of different types of statements, for example:

1. Numbers – commonly 0 and 1 for use in flags.
2. Formulae – for example

   =IF((C5/C17)>=3.75,C5/C17,"N/A")

   Note: it is not necessary to put an equals sign immediately before the logical test formula (C5/C17)>=3.75, nor before the value_if_true argument formula C5/C17.
3. Comments or "labels" – the label N/A is enclosed in inverted commas. If not in inverted commas, Excel will try to interpret the message as one of the following: a formula name; the name of a range; the address of a cell; or a logical value such as TRUE or FALSE. N/A is none of these and the formula will produce an error when Excel tries to return this as a result.

Common problems with IF statements and some simple solutions

Using equals in a test

1. Although IFs are very useful, they can easily break down. If we are testing for a particular numerical value from a formula, =0 can give spurious results because Excel shortens decimals to store them and therefore cannot calculate exactly.

   As a result of Excel's rounding, a formula which logically should give exactly zero as a result will often give a very small number, typically of approximately 0.000000000001 in value. This problem can easily be solved by using an AND statement to test to see if a number is nearly zero, i.e.

=IF(AND(cell<0.001,cell>-0.001),"Effectively zero","Not zero")

Alternatively one of Excel's rounding or other functions, such as ROUND(), ROUNDDOWN() or ABS() can be used instead.

=IF(ABS(cell)>0.001, "Not zero" , "Effectively zero")

2. Another potential problem in using equals is where the IF statement refers to a user input; for example where the user has to type "yes" or "no" into a cell and then using IF to switch to the relevant formula.

   Simple typing errors can cause big problems here: a typo in the cell entry will result in the second choice, i.e. the value if false being selected in error. This is a particularly insidious type of mistake because it will usually not result in an error message, but the wrong data or a wrong calculation being used in the model.

   Using data validation to limit data entry into the 'switch' input cell, so only the specific alternatives (for example, "yes" or "no") can be selected, will solve this problem.

The AND and OR Statements

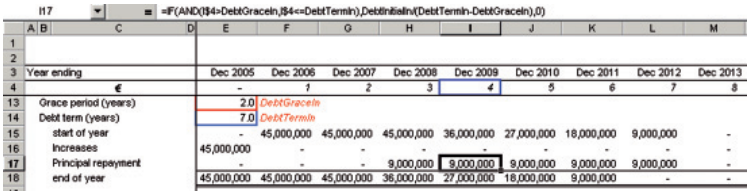
Suppose we want to choose an option if two tests are passed. To deal with these more complex problems there are two other useful tools, the AND and OR function. These functions are often used as the logical test of IF statements. The syntax of an AND statement is as follows:

=AND($test_1$,$test_2$, $test_3$….$test_n$)

In the case of the AND statement, Excel evaluates all of the tests in the formula (and there may be up to 30 of these) to see if they are TRUE or FALSE. If they are all TRUE, then the AND statement will give TRUE as a result. Otherwise it will give a FALSE.

In the following illustration, €45m of debt is raised (DebtInitialIn) on 31 December 2005 and then is to be repaid following a 2 year grace period (DebtGraceIn) over the remaining 5 years of its 7 year term (DebtTermIn).

One solution is to use AND as the logical argument, using the year counters to decide whether it is after 2 years and also within the 7 year period:



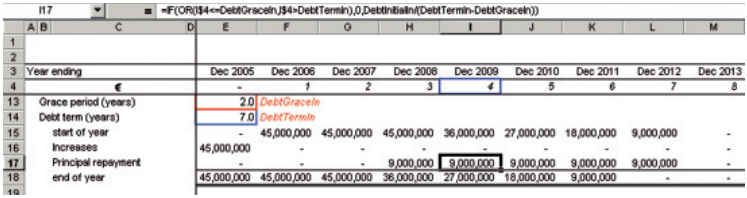
	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3			Year ending		Dec 2005	Dec 2006	Dec 2007	Dec 2008	Dec 2009	Dec 2010	Dec 2011	Dec 2012	Dec 2013
4			€		-	1	2	3	4	5	6	7	8
13			Grace period (years)		2.0	DebtGraceIn							
14			Debt term (years)		7.0	DebtTermIn							
15			start of year		-	45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-
16			Increases		45,000,000	-	-	-	-	-	-	-	-
17			Principal repayment		-	-	-	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	-
18			end of year		45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-	-

The syntax of an OR statement is the same:

$$=OR(test_1,test_2, test_3....test_n)$$

In the case of the OR statement, if any of the tests are TRUE, the statement will result in TRUE.

Another solution to the debt problem above is to decide whether the year is within the grace period or after the debt term. If this is the case, no payment is made:



	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3			Year ending		Dec 2005	Dec 2006	Dec 2007	Dec 2008	Dec 2009	Dec 2010	Dec 2011	Dec 2012	Dec 2013
4			€		-	1	2	3	4	5	6	7	8
13			Grace period (years)		2.0	DebtGraceIn							
14			Debt term (years)		7.0	DebtTermIn							
15			start of year		-	45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-
16			Increases		45,000,000	-	-	-	-	-	-	-	-
17			Principal repayment		-	-	-	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	-
18			end of year		45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-	-

Whether to use AND or OR depends on your thought process.

- If you are an inclusive modeller, then your thought process is to define everything that falls within boundaries – AND is your solution.

  In the above illustration, the logical argument is to require all the criteria to be met / to fall within the boundaries.

- If you are an exclusive modeller, then your thought process is to define anything that falls outside boundaries – OR is your solution.

  In the above illustration, the logical arguments were written so that if any were outside the limits, then no payment was made and if 'value_if_false' was returned, payments were made.

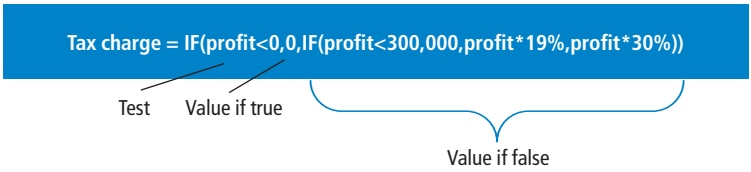
Nested statements

Excel is a very simple and flexible language and it is very easy to combine formulae to write quite complex programmes in a single cell.

For example, a corporate tax formula:

If we make a loss, we do not pay tax, if we make a profit, then if our profit is less than 300,000, we will have a tax rate of 19%, if we have profit of 300,000 or more, we will be charged at 30%.

This would be written as follows:



Here the "value if false" of the first IF statement is another IF, and both of the results from the second IF are formulae too.

The main thing to be aware of here is that as the formula gets longer, it becomes harder to work out what the formula is trying to achieve.

Data retrieval – the LOOKUP school

LOOKUP

The LOOKUP function can be useful, but should only be used if you are confident of its limitations – mainly that it is best suited to sorted numerical data.

There are two different syntaxes for the LOOKUP function:

1. LOOKUP(lookup_value, lookup_range, result_range)

The LOOKUP function searches for lookup_value in the lookup_range and returns the value in the result_range that is in the same position where:

- lookup_value is the value to search for in the lookup_range
- lookup_range is a single row or single column of data that is sorted in ascending order. The LOOKUP function searches for lookup_value in this range
- result_range is a single row or single column of data that is the same size as the lookup_range. The LOOKUP function searches for the lookup_value in the lookup_range and returns the result from the same position in the result_range.

2. LOOKUP(lookup_value, array)

The LOOKUP function searches for the lookup_value in the first row or column of the array and returns the corresponding value in the last row or column of the array where:

- lookup_value is the value to search for in the array. The values in the first row or column of the array must be in ascending order
- array is an array of values that contains both the values to search for and return

Note:

As with other lookup functions (MATCH, VLOOKUP and HLOOKUP), if the LOOKUP function cannot find an exact match, it chooses the largest value in the lookup_range (or first row/column of the array) that is less than or equal to the lookup_value. Unlike these other functions, there is no facility to change from this default (ascending order, nearest match) by use of TRUE and FALSE arguments.

- If the lookup_value is smaller than all of the values in the lookup_range (or first row/column of the array), then the LOOKUP function will return #N/A
- If the values in the lookup_range (or first row/column of the array) are not sorted in ascending order, the LOOKUP function will return the incorrect value
- If the lookup_value and lookup_range are text, then the LOOKUP function may return the incorrect value (i.e. we can't opt for an exact match within the function). Can you take the risk?

Consequently, it should only be used with a numerical lookup_value found in ascending numerical data in the lookup_range (or first row/column of the array).

For example:

	A	B	C	D
1				
2		**Date**	**SBRY**	**Change**
3		02 Jul 07	285.25	
4		03 Jul 07	286.25	0.35%
5		04 Jul 07	286.00	(0.09%)
6		05 Jul 07	283.00	(1.05%)
7		06 Jul 07	282.50	(0.18%)
8		09 Jul 07	277.75	(1.68%)
9		10 Jul 07	281.75	1.44%
10		11 Jul 07	282.25	0.18%
11		12 Jul 07	283.25	0.35%
12		13 Jul 07	286.00	0.97%
13		16 Jul 07	282.00	(1.40%)
14		17 Jul 07	285.50	1.24%
15		18 Jul 07	282.75	(0.96%)
16		19 Jul 07	280.00	(0.97%)
17		20 Jul 07	280.00	--
18		23 Jul 07	279.75	(0.09%)
19		24 Jul 07	280.00	0.09%
20		25 Jul 07	279.50	(0.18%)
21		26 Jul 07	276.00	(1.25%)
22		27 Jul 07	280.25	1.54%
23		30 Jul 07	280.50	0.09%
24		31 Jul 07	279.50	(0.36%)

Based on the above:

LOOKUP(lookup_value, lookup_range, result_range)

=LOOKUP(12 Jul 07, B3:B24, C3:C24) would return 283.25

=LOOKUP(1 Jun 07, B3:B24, C3:C24) would return #N/A

=LOOKUP(15 Jul 07, B3:B24, C3:C24) would return 286.00

LOOKUP(lookup_value, array)

=LOOKUP(12 Jul 07, B3:D24) would return 0.35%

=LOOKUP(1 Jun 07, B3:D24) would return #N/A

=LOOKUP(15 Jul 07, B3:D24) would return 0.97%

IF, although perhaps the most useful function for creating flexibility in models, is limited in its applications. If we have a problem involving a selection of possible answers, rather than a simple yes / no, then IF rapidly becomes difficult to use.

Excel will allow us to use a maximum of 7 IFs in a statement. This is very hard work to both code and audit.

The following functions can help resolve this problem.

- CHOOSE
- MATCH
- INDEX
- OFFSET
- VLOOKUP
- HLOOKUP.

They can all be found in Insert; Function; Lookup & Reference.
Which function to use depends on:

- The flexibility required
- The way the data is sorted
- The sort of information that needs to be returned.

CHOOSE

A CHOOSE function takes the role of up to 29 embedded IF statements and is used widely in scenario management. It is driven by a selector cell which must be an integer between 1 and 29 and consequently requires references to up to 29 different target cells.

	A	B	C	D	E	F	G	H	I	J	K
1											
2				31-Mar	30-Apr	31-May	30-Jun	31-Jul	31-Aug	30-Sep	31-Oct
3	Sales scenaria										
4	1	Management case		342.0	365.9	369.6	362.2	333.2	283.2	345.6	362.8
5	2	Base case		330.0	353.0	357.0	350.0	322.0	274.0	334.0	351.0
6	3	Best case		360.0	385.2	389.1	381.3	350.8	298.2	363.7	381.9
7	4	Downside case		310.0	331.7	335.0	328.3	302.1	256.7	313.2	328.9
8	5	Single driver case		275.0	294.0	297.0	291.0	268.0	228.0	278.0	292.0
9											
10	Scenario selected		2								
11											
12	Income statement										
13		Sales		=CHOOSE($C$10,D4,D5,D6,D7,D8)				322	274	334	351
14											

=CHOOSE (index_num,value1,value2,...)

In the above illustration, the scenario to be used to drive the income statement sales figure is selected using C10 – known as the index_num in the CHOOSE function. In order to use CHOOSE, this must be a positive integer (not text) – value of 2 in this case.

The reference of the cell to be used if the selector cell (or index_num) is 1 is the next argument in the function (value1 – if C10 is 1 this indicates that the first or "Management case" has been chosen and so the 342 in cell D4 should be referenced), and then 2 (second scenario and so D5), etc. up to the number of options (maximum 29, although only 5 used in the above).

The CHOOSE function is easy to use, but requires a significant amount of input – i.e. if 10 options are to be used, then the CHOOSE function requires reference to the selector cell and the cell to be returned for each of these 10 options in the correct order.

This, together with the manual nature of extending the CHOOSE function for, say, adding new scenarios, may cause modelling errors to creep in. If the user enters an invalid scenario number #VALUE! errors are generated. If the order of the option listed should change or if an option should be added or deleted, the dependent CHOOSE function will need updating. Consequently, where the data to be selected is large and / or will be extended, then other functions may prove more flexible and robust.

MATCH

MATCH is a much under-used and relatively straightforward function. It returns the relative position of an item in a 1-dimensional data area, i.e. the output is a number referring to the position within a series.

As a result, it is often used to identify coordinates for use in other lookups – namely INDEX, OFFSET, VLOOKUP and HLOOKUP.

	A	B	C	D	E	F	G	H	I	J
11	**Income statement - monthly**			**31-Mar**	**30-Apr**	**31-May**	**30-Jun**	**31-Jul**	**31-Aug**	**30-Sep**
12				1	2	3	4	5	6	7
13		Sales		330	353	357	350	322	274	334
14										
15	**Income statement - periods**			**30-Jun**	**31-Dec**	**30-Jun**	**31-Dec**	**30-Jun**		
16		Start month		1	5	11	17	23		
17		End month		=MATCH(D15,DatesMonthly,0)			22	28		
18										
19		Sales		1,390	2,106	2,254	2,268	2,430		
20										

In the above illustration, the MATCH function is used to indicate the period number in which the semi-annual sales finish. 30 June is the 4th monthly

period in the sequence and so the MATCH function is used to calculate this. The function is of the form:

=MATCH(lookup_value,lookup_array,match_type)

- lookup_value

  The value we want to find the relative position of. This is the semi-annual period end (30 June in cell D15) above.

- lookup_array

  The one-dimensional data area in which the lookup_value can be found. This area (D11:AE11) has been named DatesMonthly for ease of reference. 30 June appears in cell G11 – the 4th item in the data area.

- match_type

  A key element in many lookup formulae, not just MATCH. The reference 0 has been used above to indicate that only an exact match is possible. If the value in D15 were anything other than a month end (say 28 June) then the MATCH equation would not be able to find that value in DatesMonthly resulting in #N/A.

  The other possibilities for match_type are 1 or –1. These require the data area (lookup_array) to be sorted in ascending order or descending order respectively. If match_type is 1, MATCH finds the largest value that is less than or equal to lookup_value. If the value in D15 is 28 June then MATCH returns 3: 31 May is the next lowest value. If match_type is -1, MATCH finds the smallest value that is greater than or equal to lookup_value. If the value in D15 is 28 June then MATCH returns #N/A: the DatesMonthly are not sorted in descending order.

  If this argument is omitted, Excel assumes that the match_type is 1.

INDEX

The simplest explanation of INDEX is:

=INDEX(range,position)

Range is the area to be looked up. Position is a value corresponding to the location of the value to be returned. Position must be a positive whole number. Position 1 is always the left hand cell in a row, or the top cell in a column.

There are two forms of INDEX:

1. =INDEX(array,row_num,column_num)
2. =INDEX(reference,row_num,column_num,area_num)

Both are used to return the contents (or position) of a cell as defined by its coordinates from within a data area (or data areas for the reference version). INDEX is a highly flexible and robust function as long as the coordinates (row and column position) can be identified.

The array version

=INDEX(array,row_num,column_num)

If a data area is 5 rows deep by 6 columns across and we wish to extract the value in the 3rd row and 6th column. The formula becomes:

=INDEX(DataArea, 3, 6)

The row_num and column_num are often found by use of the MATCH function. For example, in the following illustration we are trying to find the charge out rate for a director in Hong Kong. The data area has been set up so that it is easy to interpret, using text as row and column headers. Similarly, the way to select the data is based on these headings (selected in cells E14 and E15). Only once these selections of Hong Kong and director have been turned into numbers can we use an INDEX function.

F17 = =INDEX(D3:H11,F14,F15)

	A	B	C	D	E	F	G	H
1		Data grid						
2				Analyst	Associate	VP	Director	MD
3			London	345	690	1,380	2,760	5,520
4			Paris	293	587	1,173	2,346	4,692
5			Milan	264	528	1,056	2,111	4,223
6			New York	373	745	1,490	2,981	5,962
7			Chicago	317	633	1,267	2,534	5,067
8			Los Angeles	348	697	1,394	2,787	5,574
9			Hong Kong	311	621	1,242	2,484	4,968
10			Singapore	295	590	1,180	2,360	4,720
11			Tokyo	357	714	1,428	2,857	5,713
12								
13		Desired number						
14		row selector			Hong Kong	7	=MATCH(E14,C3:C11,0)	
15		column selector			Director	4	=MATCH(E15,D2:H2,0)	
16								
17		Charge out rate				2,484		

One dimensional data

Often, the trick with such functions is finding a way in which it will help.

The following is an asset schedule for one class of assets which calculates the depreciation charge (in row 13) based on the cumulative cost at the end of the year (in row 9). The key is to ensure that assets which have been fully depreciated drop out of the calculation – which is where row 8 comes in. If the asset life (in E3) was to always stay the same at 4 years, then we could merely link cell J8 to F2. However, to ensure a fully flexible solution the equation in row 8 needs to be flexible also.

J8 = =IF(J1<=Life,0,INDEX(Capex,,J$1-Life))

	C	E	F	G	H	I	J	K	L
1	Years	1	2	3	4	5	6	7	8
2	Capex	436	324	460	540	344	678	876	654
3	Life	4 years							
4									
5	Cost								
6	Start	-	436	760	1,220	1,760	1,668	2,022	2,438
7	Capex	436	324	460	540	344	678	876	654
8	Disposals	-	-	-	-	436	324	460	540
9	End	436	760	1,220	1,760	1,668	2,022	2,438	2,552
10									
11	Depreciation								
12	Start	-	109	299	604	1,044	1,025	1,207	1,356
13	Charge	109	190	305	440	417	506	610	638
14	Disposals	-	-	-	-	436	324	460	540
15	End	109	299	604	1,044	1,025	1,207	1,356	1,454
16									
17	Book value	327	461	616	716	643	816	1,082	1,098
18									

The trick with INDEX, as with many functions, is to know what the answer should be. In cell J8 (in year 6) we want to eliminate the assets acquired in year 2 – the 324. This is the number which appears in the second column of the data area in E2:L2 (named Capex). As we know the coordinates of this within the data area (row number irrelevant as it is a one row data area; and second column) we can use INDEX to pick up the required cell.

Analysing the above formula but ignoring the IF statement:

- array

  The data area from which the target value of 324 is to be extracted - E2:L2 (named Capex).

- row_num

  The row number within the data area where the target value of 324 is situated. In the above, the data area (Capex) is a one row array and so it can be ignored.

- column_num

  The column number within the data area where the target value of 324 is situated. In the above, the 324 is in the second column of the data area

and so the column number coordinate should be 2. The "J$1-Life" [6-4] is merely a way of ensuring we have the appropriate column counter as the formula is copied along row 8.

In summary, the formula is:

= INDEX (E2:L2, leave blank, 2)

which returns the value in the second column of the range contained in E2:L2.

The reference version

=INDEX(reference,row_num,column_num,area_num)

The reference version comes into its own when there are different versions of the same data. It could be that:

- The input assumptions are based on three different options
- There are income statements for 10 different companies / divisions
- There are costing structures for 25 different products; etc.

The key is to ensure that each data area is set up in the same way and that row and column counters are introduced.

In the following illustration, there are operating contribution calculations set out in the same way for each of 4 regions (North, South, East and West), each of which has been appropriately named (e.g. North is the name for the range E13:J19). We wish to select one of these regions (using cell C2) as the output in rows 3 to 9.

E6 =INDEX((North,South,East,West),$A6,E$2,$B$2)

	A	B	C	D	E	F	G	H	I	J
1					30-Apr	31-May	30-Jun	31-Jul	31-Aug	30-Sep
2		2	South		1	2	3	4	5	6
3	1		Sales		459	464	455	419	356	434
4	2		COGS		260	257	248	228	195	241
5	3		Gross profit		199	207	207	191	161	193
6	4		Wages		55	55	52	50	50	50
7	5		Other variable costs		80	83	83	76	64	77
8	6		Other fixed overheads		38	38	38	38	38	38
9	7		Operating contribution		26	31	34	27	9	28
10										
11										
12			**North**							
13			Sales		353	357	350	322	274	334
14			COGS		192	198	191	175	150	185
15			Gross profit		161	159	159	147	124	149
16			Wages		39	40	38	35	35	35
17			Other variable costs		64	64	64	59	50	60
18			Other fixed overheads		30	30	30	30	30	30
19			Operating contribution		28	25	27	23	9	24
20										
21			**South**							
22			Sales		459	464	455	419	356	434
23			COGS		260	257	248	228	195	241
24			Gross profit		199	207	207	191	161	193
25			Wages		55	55	52	50	50	50
26			Other variable costs		80	83	83	76	64	77
27			Other fixed overheads		38	38	38	38	38	38
28			Operating contribution		26	31	34	27	9	28
29										
30			**East**							
31			Sales		388	393	385	354	301	367
32			COGS		211	218	210	193	165	204
33			Gross profit		177	175	175	161	136	163

- reference (North, South, East, West)

  This defines the various data areas from which the data is to be retrieved. Each of the data areas is the same size and has been named for ease of identification.

  Note: all the data areas must be contained within a set of parentheses inside the INDEX function.

- row_num $A6

  We are trying to return wages which is in the 4th row of the data area called South. As the data area is of the same dimensions as the summary, we can put in row counters in column A to help.

- column_num E$2

  We are trying to return the result for April which is in the first column of the data area called South. As the data area is of the same dimensions as the summary, we can put in column counters in row 2 to help.

- area_num $B$2

  This identifies which of the data areas (defined in reference) is to be used. As South is the second in the list, then we need to convert the selector word "South" into the number 2. MATCH again comes in handy.

For three parts of the function, numbers have been used to identify the row, column and data area. If we are concerned about presentation, these counters could be hidden using white text.

OFFSET

Like the INDEX function, the OFFSET function uses row and column coordinates to identify the value (or position) of the target cell. In simple terms, the OFFSET function identifies the target cell in relation to how many rows and columns it is positioned away from a starter cell – the data area does not need to be identified.

Using the same example as for the INDEX function, the charge out rate for a director in Hong Kong can be found using OFFSET.

F17 = =OFFSET($C$2,F14,F15)

	A	B	C	D	E	F	G	H
1		Data grid						
2				Analyst	Associate	VP	Director	MD
3			London	345	690	1,380	2,760	5,520
4			Paris	293	587	1,173	2,346	4,692
5			Milan	264	528	1,056	2,111	4,223
6			New York	373	745	1,490	2,981	5,962
7			Chicago	317	633	1,267	2,534	5,067
8			Los Angeles	348	697	1,394	2,787	5,574
9			Hong Kong	311	621	1,242	2,484	4,968
10			Singapore	295	590	1,180	2,360	4,720
11			Tokyo	357	714	1,428	2,857	5,713
12								
13		Desired number						
14		row selector			Hong Kong	7	=MATCH(E14,C3:C11,0)	
15		column selector			Director	4	=MATCH(E15,D2:H2,0)	
16								
17		Charge out rate				2,484		

=OFFSET(reference,rows,columns)

- reference $C$2

  This is the "starter cell" or the reference point from which the OFFSET rows and columns are counted. To make the row and column counting easier, with two-dimensional data areas it is usually best to have this cell immediately above and to the left of the data area as the reference cell.

- rows, columns F14, F15

As with the INDEX function, we need to turn the row and column selectors (in E14 and E15 respectively) into numbers so that they can be used within OFFSET. Hong Kong is in the seventh row of the city names and Director is in the fourth column of job titles – MATCH has been used to identify these. Likewise, they are 7 rows and 4 columns respectively away from the reference cell C2.

The row and column numbers can be negative, in which case the target cell will be above and / or to the left of the reference cell.

Identifying the reference

OFFSET is often used to locate the contents of a target cell. However, it can also be used to identify the position of a cell from within a range, or a range from within a range for use in other functions.

In the charge out illustration, OFFSET can be used to identify the charge out rates for all of the Directors or the Hong Kong office using the extended version:

=OFFSET(reference,rows,columns,height,width)

Using the extended function to find the reference of the Director charge out rates:

=OFFSET($C$2,1,F15,9,1)

The range we are looking for starts 1 row (rows) below the starter cell C2 (reference) and 4 columns to the right (cols – using F15). It is 9 rows deep (height) and 1 column wide (width).

An alternative is:

=OFFSET(C3,,F15,9)

This time the starter cell (C3) is in the same row as the start of the range. Consequently, we do not need to define how many rows away the range starts (the second argument, rows, is left blank). Additionally, as the default (height and) width is 1 then we do not need to populate the final (width) argument.

The above formulae have identified a reference and are only of use when incorporated within another function. For example:

=AVERAGE(OFFSET(C3,,F15,9))

will return the average charge out rate for the directors.

INDEX vs. OFFSET

INDEX and OFFSET both require column and row coordinates to identify the target cell or cells. However, they both have their idiosyncrasies:

1. Defining ranges for use in other functions

   If a range from within a range is to be defined for use in other functions then the full version of OFFSET has been created for this purpose. However, two INDEX functions can be used to define the start and end positions of a range. The start and end point can be used to define the range for a function if the two INDEX functions are separated by a colon within the equation. For example:

   =SUM (INDEX (DataArea,3,6) : INDEX (DataArea,4,10))

2. Auditing

   An INDEX function is easier to audit. If F2, the trace precedents or the Ctrl-[is pressed, then the components of the formula are shown. If the OFFSET function is used, then the data area from which the target cell or range is to be retrieved, is not shown as it is not part of the function.

   Additionally, if we are trying to find the dependents of a cell, it will not be identified as a precedent of an OFFSET whereas it will indicate the relationship with the INDEX. This can cause problems as whole tracts of data may appear to have no links with any other parts of the model if OFFSET is used – and could, therefore be changed or deleted without understanding the impact until it is too late. This may prove difficult to audit for those users of the model who are unfamiliar with OFFSET.

3. Volatility

   OFFSET is volatile whilst INDEX is not. Volatile functions always recalculate when the model is calculated, even if their components have not changed. For most users this is whenever anything is changed anywhere in the model.

   This means that if the model is heavily populated with OFFSET functions, it will take a long time to recalculate.

4. Macros

   The OFFSET function is a fundamental tool in visual basic.

The deficiencies identified by points 2 and 3 above are reasons why the OFFSET function is seldom used at Rothschild.

VLOOKUP

A flexible solution for multiple option selection is VLOOKUP. However, it may require some planning as VLOOKUP requires the data to be set out in a specific way.

If we take the simple case of recommending whether to buy, sell etc. a stock based on the target price generated by the model, then we see how simple a VLOOKUP solution can be.

The value of a share is computed using a DCF valuation approach and then this value is compared to the current share price.

The threshold for a "buy" recommendation is that the current share price is at a discount of up to 15% to the DCF share valuation, up to no premium for an "Add" recommendation and so on.

	A	B	C	D	E	F
1						
2						
3						
4		Premium to DCF implied price target (%)	Vlookup Recommend-ation		Decision Box	
5	Tesco	24.5%	Sell		-100%	Buy
6	Asda	3.0%	Hold		-15%	Add
7	Carrefour	-22.0%	=VLOOKUP(B7,DecisionBox,2)		0%	Hold
8	Sainsbury	-14.7%	Add		10%	Reduce
9	Ahold	-29.0%	Buy		20%	Sell
10						

The lookup table – named DecisionBox

This is easier to think about if we know what the answer should be. Our model suggests that the current share price undervalues Carrefour shares by 22%. Looking at the decision box would indicate -100% to -15% is a Buy; -15% to 0% is Add; 0% to 10% is a Hold etc. Consequently, we think that Carrefour should be a Buy.

The VLOOKUP formula at its simplest has three components:

=VLOOKUP(lookup_value,table_array,col_index_num)

- lookup_value B7

  This is the output driver (the -22% premium to DCF implied price target for Carrefour in cell B7)

- table_array E5:F9 – named DecisionBox

The data area where the required result is located (the decision box with the grid of premia and investor action). The lookup_value will be checked against the values in the first column of the table_array – i.e. the values to be checked must be in the first column.

- col_index_num 2

  The column number of the required result (the investor action) within the lookup table (i.e. the second column of the DecisionBox). The first two arguments of the equation have narrowed the result down to the specific row in the specific data area. The col_index_num indicates which column in that data area to then select from.

How VLOOKUP works is very simple: Excel takes the lookup_value (-22%) and looks down the first column of the table_array (-100%, -15%, 0%, 10%, 20%) until it finds a match. If it cannot find an exact match, then Excel chooses the next nearest lower number instead (i.e. the last number it is bigger than on the way down: -100% in this case).

In the case of Tesco, it will get to the last line of the table before it stops. Having chosen a line in this way, Excel then chooses the result from the column number (2) you have specified.

Beware

1. The data in the first column must be in ascending order down the table for this kind of VLOOKUP to work properly
2. The column number is just that. Excel will consider the first column of the lookup table as column 1, the second column as 2 and so on. If the lookup table does not have enough columns, i.e. the column number is bigger than the total number of columns in the table, an error message will be returned.

The final argument – TRUE / FALSE

In the example above, we have not included a final fourth argument. The final argument is TRUE or FALSE. If we put TRUE or omit the last argument, then VLOOKUP works as in the above example.

If we enter FALSE, then VLOOKUP accepts only exact matches. If an exact match cannot be found, then a #N/A error message will be returned. This form of VLOOKUP must be used when the selector cell is text (or if column 1 is not in ascending order).

	A	B	C	D	E	F	G
1							
2		Company		Country	Price	Mkt cap (local)	
3							
4		Delhaize		Belgium	€54.25	€4,995 m	
5		Carrefour		France	€53.00	€37,691 m	
6		Casino		France	€89.10	€9,770 m	
7		Metro		Germany	€36.11	€11,800 m	
8		Ahold		Netherlands	€23.95	€22,057 m	
9		Laurus		Netherlands	€1.15	€149 m	
10		Jeronimo Martins		Portugal	€7.58	€725 m	
11							
12							
13				Price			
14		Casino		=VLOOKUP(B14,Data,4,FALSE)			
15							

The result of the formula in cell D14 is €89.10 (the value in the 4th column of the Casino row). The selector cell is B14, which this time is text (Casino). Additionally, the data in the first column of the data area (named Data in cells B2:F10) is not sorted in any particular order. Consequently, the last argument in the VLOOKUP must be FALSE (or 0).

Strangely, if FALSE was missed off, the VLOOKUP may give

1. The right answer
2. Another erroneous value or
3. #N/A.

It is the second one of these which is the dangerous one – a number appears and so it is assumed that it must be right, but it may not be. Therefore, when using text as a selector in VLOOKUPs, ALWAYS USE FALSE.

HLOOKUP

VLOOKUP and HLOOKUP work in very similar ways. The difference in their use depends on the way the data is arranged:

- VLOOKUP requires the lookup_value to be represented in the first column of the data area (or table_array) – that is, the lookup is driven by vertically looking down the first column of the data area to find the correct row (and then finding the appropriate column)
- HLOOKUP requires the lookup_value to be represented in the first row of the data area (or table_array) – that is, the lookup is driven by horizontally looking across the first row of the data area to find the correct column (and then finding the appropriate row).

In the comparable company table below, supposing the company (Ahold – in row 8 of the spreadsheet, but row 7 of the data area) was a given and we wanted a formula that would return Netherlands if Country was chosen, €23.95 if Price was chosen and so on.

	A	B	C	D	E	F
1						
2		**Company**		**Country**	**Price**	**Mkt cap (local)**
3						
4		Delhaize		Belgium	€ 54.25	€ 4,995 m
5		Carrefour		France	€ 53.00	€ 37,691 m
6		Casino		France	€ 89.10	€ 9,770 m
7		Metro		Germany	€ 36.11	€ 11,800 m
8		Ahold		Netherlands	€ 23.95	€ 22,057 m
9		Laurus		Netherlands	€ 1.15	€ 149 m
10		Jeronimo Martins		Portugal	€ 7.58	€ 725 m

=HLOOKUP(lookup_value,table_array,row_index_num,range_lookup)

=HLOOKUP(C12,Data,7,false).

- lookup_value C12 (Country in this case)

  As with VLOOKUP, this is the output driver (the word Country). This points to which type of output value we are looking for.

- table_array B2:F10, named Data

  The data area where the required result (Netherlands) is located. The lookup_value, Country, will be checked against the values in the first row of the table_array – i.e. the values to be checked must be in the first row / header of the data area.

- row_index_num 7

  The first two arguments have narrowed it down so that the lookup is looking down the Country column of the range named Data. The 7 indicates that we are looking for the 7th row in that column – that relating to Ahold.

  The 7 has been hard-wired into the formula for illustration only. It should not be a hard input number but related to a row counter which could be derived using MATCH to find where Ahold is positioned.

- range_lookup false (or 0)

  As the first row is not sorted in any particular order and the lookup_value is text, we want an exact match only (not the closest approximation).

As we have seen with VLOOKUP, if the FALSE argument is not added the HLOOKUP may give:

1. The right answer
2. Another erroneous value or
3. #N/A.

Volatile functions

Volatile functions recalculate each time a change of any sort occurs in any cell on any sheet. Most functions will only recalculate if a cell which they are referencing has changed, i.e. a volatile function in a formula means that cell **will always be recalculated at each recalculation** even if it does not appear to have any changed precedents and will lead to the Excel prompt to save changes to the model when you close it. The result is a model which takes longer to calculate.

To understand the issue, enter the formula:

=RAND()

in any cell. On Pressing F9 (the calculate key), the value in the cell will recalculate. If cells, rows or columns are deleted or inserted or another formula is entered elsewhere, the cell will also recalculate. This illustrates how these volatile functions and shows that many actions is Excel cause all volatile functions to automatically recalculate.

Consequently, avoid volatile functions wherever possible. Using volatile functions sparingly will afford the benefit that the model will recalculate faster because it is only recalculating what it needs to.

The reason functions are specified as volatile is because Excel has no means of knowing when to recalculate them because they are in some sense outside of the normal dependency chain. INDIRECT for example, as its name implies, only has an indirect link with its source data – the rangename. Random number functions do not depend on anything, so the only safe thing to do is to generate a new random number every time the spreadsheet is recalculated.

Excel's volatile functions

Some of Excel's functions are obviously volatile: RAND(), RANDBETWEEN(), NOW(), TODAY()

Others are less obviously volatile: OFFSET(), CELL(), INDIRECT(), INFO()

Some are volatile in some versions of Excel but not in others: INDEX()became non-volatile in Excel 97.

Using a volatile function in a formula will flag the cell containing the formula as volatile, even if the volatile function never gets executed. e.g.

```
=IF(1<2,99,NOW())
```

will always return 99 and the volatile NOW() function will never be called, but the cell containing the formula will be treated as volatile.

If the result of volatile functions is going to be used frequently throughout a model, avoid the temptation of nesting these functions within other functions. Instead, simply type the volatile function into a single cell and reference that cell from within other functions. This alone can potentially cut down on the amount of volatile functions by hundreds, if not thousands at times, and speed up the model's performance.

Conditional formats

Because conditional formats need to be evaluated at each calculation any formulae used in a conditional format is effectively volatile. Actually conditional formats seem to be super-volatile: they are evaluated each time the cell that contains them is repainted on the screen, even in Manual calculation mode, although VBA functions used in conditional formats will not trigger breakpoints when executed by the repaint.

Arrays

An array is a rectangular range of cells or values. In Excel, data can reside in a single row (called a one-dimensional horizontal array), a column (a one-dimensional vertical array), or multiple rows and columns (a two-dimensional array).

Most data analysis is done in one cell and then copied to others, but advocates of arrays would suggest that this approach is:

- Cumbersome

- Error-prone
- Hard to follow and maintain.

Most of these potential problems can be avoided with a rigorous approach to model building. However, an array formula returns an array that is spread over the cells and so has the advantages of:

- One array=>One formula
- Faster computations.

An array formula is a formula that can perform multiple calculations on one or more of the items in an array. Array formulae can return either multiple results or a single result. For example, an array formula can be placed in a range of cells and calculate a column or row of subtotals. An array formula can also be placed in a single cell and calculate a single amount. An array formula that resides in multiple cells is called (logically enough) a multi-cell formula, and an array formula that resides in a single cell is called a single-cell formula.

Illustration

Using the following data:

Site	Product	Number Sold	Unit Price	Total Sales
North	Tailored	5	2,200	
	Menu	4	1,800	
South	Tailored	6	2,300	
	Menu	8	1,700	
East	Tailored	3	2,000	
	Menu	1	1,600	
West	Tailored	9	2,150	
	Menu	5	1,950	
Central	Tailored	6	2,250	
	Menu	8	2,000	
Total sales				

To create a multi-cell array formula

To multiply the values in the array (the cell range C2 through D11):

1. Select cells E2 through E11
2. Enter the following formula =C2:C11*D2:D11
3. Press CTRL+SHIFT+ENTER.

Excel surrounds the formula with braces ({ }) and places an instance of the formula in each cell of the selected range. This happens very quickly, so what you see in column E is the total sales amount for each product for each region.

To create a single-cell array formula

1. Select B13
2. Enter the following formula =SUM(C2:C11*D2:D11)
3. Press CTRL+SHIFT+ENTER.

In this case, Excel multiplies the values in the array (the cell range C2 through D11) and then uses the SUM function to add the totals together. The result is a grand total of 111,800 in sales.

(Note: The same result could have been arrived at without the use of arrays by the use of the SUMPRODUCT function.)

Site	Product	Number Sold	Unit Price	Total Sales
North	Tailored	5	2,200	11,000
	Menu	4	1,800	7,200
South	Tailored	6	2,300	13,800
	Menu	8	1,700	13,600
East	Tailored	3	2,000	6,000
	Menu	1	1,600	1,600
West	Tailored	9	2,150	19,350
	Menu	5	1,950	9,750
Central	Tailored	6	2,250	13,500
	Menu	8	2,000	16,000
Total sales	111,800			

This can be a very powerful type of formula. For example, say there are 15,000 rows of data. Part or all of that data can be summed with a single formula in a single cell.

Also, notice that the single-cell formula is completely independent of the multi-cell formula. This points to another advantage of using array formulas – flexibility. Any number of actions, such as changing the formulae in column E or deleting that column altogether, will not affect the single-cell formula.

Rules for entering and changing array formulae

The main rule is to press CTRL+SHIFT+ENTER whenever you need to enter or edit an array formula. This rule applies to both single-cell and multi-cell formulae. However, whenever working with multi-cell formulae, there are additional rules to follow:

- You must select the range of cells to hold the results before you enter the formula
- You cannot change the contents of an individual cell in an array formula
- You can move or delete an entire array formula, but you cannot move or delete part of it. In other words, to shrink an array formula, you first delete the existing formula, and start again
- You cannot insert blank cells into a multi-cell array formula.

Expanding an array formula

At times, it may be necessary to expand an array formula (though it is not possible to shrink them). The process is not complicated, as long as the rules listed in the previous section are followed.

Illustration

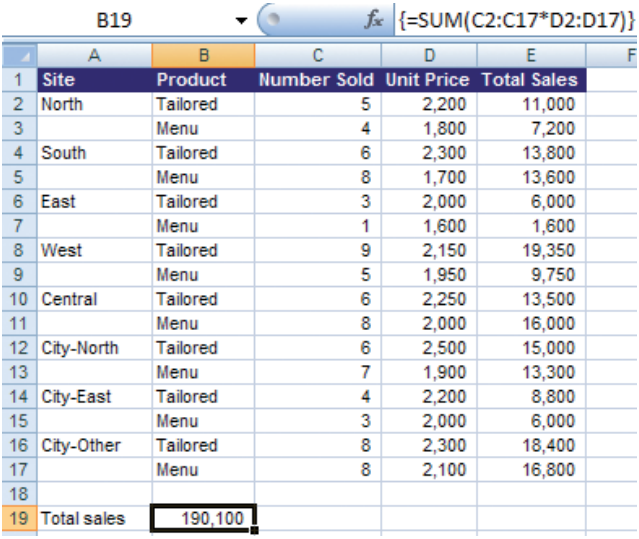
To add the following data to the previous illustration

Site	Product	Number Sold	Unit Price
City-North	Tailored	6	2,500
	Menu	7	1,900
City-East	Tailored	4	2,200
	Menu	3	2,000
City-Other	Tailored	8	2,300
	Menu	8	2,100

In the sample model insert these additional lines of data into the model starting at cell A12. Note, that the new data cannot be entered into the middle of the current data due to the multi-cell array formula.

- Select the range of cells that contains the current array formula (E2:E11), plus the empty cells next to the new data (E12:E17)
- Press F2 and edit the formula to extend the C11 to C17 and change D11 to D17
- Press CTRL+SHIFT+ENTER. Excel places an instance of the formula in the new cells.

The same process can be followed to edit the single-cell array formula in B19:



	A	B	C	D	E	F
1	Site	Product	Number Sold	Unit Price	Total Sales	
2	North	Tailored	5	2,200	11,000	
3		Menu	4	1,800	7,200	
4	South	Tailored	6	2,300	13,800	
5		Menu	8	1,700	13,600	
6	East	Tailored	3	2,000	6,000	
7		Menu	1	1,600	1,600	
8	West	Tailored	9	2,150	19,350	
9		Menu	5	1,950	9,750	
10	Central	Tailored	6	2,250	13,500	
11		Menu	8	2,000	16,000	
12	City-North	Tailored	6	2,500	15,000	
13		Menu	7	1,900	13,300	
14	City-East	Tailored	4	2,200	8,800	
15		Menu	3	2,000	6,000	
16	City-Other	Tailored	8	2,300	18,400	
17		Menu	8	2,100	16,800	
18						
19	Total sales	190,100				

Adding logic to arrays

As seen, arrays perform the same action many times. Consequently, the same logical argument can be performed many times.

Illustration

Suppose we want to find how many of a certain product was sold or what the revenue was for that product.

If we want to calculate the total number of tailored products sold we could create a series of IF statements in column F of the =IF(B2="tailored",C2,0) type (or a multi-cell array of the same type {=IF(B2="tailored",C2,0)}) and then sum these up.

As the same logical argument and the same result if true or false is used for the whole range, then a single-cell array formula can be used.

To calculate the total number of tailored items sold in cell C20:

{=SUM(IF(B2:B17="tailored",C2:C17,0))}

i.e., the IF statement looks in the array B2:B17 for those matching "tailored", and then returns the number of units sold for each. By placing the SUM around it, all the units fulfilling the criteria are summed.

(Note: the Excel function SUMIF would produce the same result without the use of arrays.)

To take this further and calculate the revenue from all tailored sales in E20:

{=SUM(IF($B$2:$B$17="tailored",$C$2:$C$17*$D$2:$D$17,0))}

(There is no one function within Excel which could perform this without the use of arrays.)

E20 fx {=SUM(IF($B$2:$B$17=F20,$C$2:$C$17*$D$2:$D$17,0))}

	A	B	C	D	E	F	G	H	I
1	Site	Product	Number Sold	Unit Price	Total Sales				
2	North	Tailored	5	2,200	11,000				
3		Menu	4	1,800	7,200				
4	South	Tailored	6	2,300	13,800				
5		Menu	8	1,700	13,600				
6	East	Tailored	3	2,000	6,000				
7		Menu	1	1,600	1,600				
8	West	Tailored	9	2,150	19,350				
9		Menu	5	1,950	9,750				
10	Central	Tailored	6	2,250	13,500				
11		Menu	8	2,000	16,000				
12	City-North	Tailored	6	2,500	15,000				
13		Menu	7	1,900	13,300				
14	City-East	Tailored	4	2,200	8,800				
15		Menu	3	2,000	6,000				
16	City-Other	Tailored	8	2,300	18,400				
17		Menu	8	2,100	16,800				
18									
19	Total sales	190,100							
20	Total Tailored		47		105,850	Tailored			
21	Total Menu		44		84,250	Menu			

Advantages and disadvantages of arrays

Array formulae offer these advantages:

- Consistency

  Clicking any of the cells from E2 downward, the same formula is revealed. That consistency can help ensure greater accuracy.

- Safety

  Part of a multi-cell array formula cannot be overwritten. For example, clicking cell E3 and pressing DELETE would not work. It is necessary to

either select the entire range of cells and change the formula for the entire array, or leave it as is.

- Smaller file sizes

  A single array formula can be used instead of several intermediate formulae. For example, the model created for this exercise uses two array formulae. Standard formulae (such as =C2*D2), would have required 11 different formulas.

Array formulae can work what seems like magic, but they also have some disadvantages:

- Do not forget to use CTRL+SHIFT+ENTER

  Remember to press those keys whenever entering or editing an array formula.

- Other users may not understand the array formulae

  Array formulae are relatively undocumented, so if other people need to modify models, it is necessary to either avoid array formulae or make sure they understand how to change them.

- Depending on the speed of the system, large array formulas can slow down calculations.

Dates

When a date is used in Excel, it is identified as a number providing it is written in a valid date format. For example, 30 July 1966 day is the 24,318th day of the world, according to Microsoft i.e. it has been given the unique number 24,318. This can be seen by entering the date 30/07/66 and then stripping the formatting from the cell by using Control+Shift+1. The cell can be reformatted to the date format using Control+#.

So when did the world begin? The first day of the world (according to Microsoft), i.e. number 1, is 1 January 1900, despite a sizeable body of evidence to suggest otherwise. This is an important date: if Excel knew that the world started on that date then any other date is merely a number of days from 1 January 1900. Hence, a unique number can be allocated.

Date formats

1 January 1900 was a Sunday (which Excel, by default, treats as the first day of the week). Consequently, not only can Excel count the number of days from 1 January 1900, but also can very easily work out which day of the week it is.

As dates are numbered, they can be formatted in the same way as other numbers. For example, to format the date 4 July 2006 (number 38,537):

- Control-1, Number and Custom

Days	d	dd	Ddd	dddd
	4	04	Mon	Monday
Months	m	mm	Mmm	mmmm
	7	07	Jul	July
Years	y	yy	Yyy	yyy
	06	06	2006	2006

Date functions

Appreciating that a date is a number adds a lot of functionality. Some of these functions are not in the standard set-up of Excel and may need to be added:

- Tools, Add-ins
- Select Analysis Toolpak

YEAR, MONTH, DAY etc.

Where the data is in 3 different cells, being day of the month (28), number of month (2 for February), and year (2004), this can all be combined into '28 February 2004' by the Date function:

=DATE(year,month,day)

The result in the cell is now the unique number for 28 February 2004 which can be formatted as appropriate.

The YEAR, MONTH and DAY functions can be used to reverse this process to find the component parts of a particular date.

WEEKDAY can be used to find out which day of the week a date is from 1-7 (although this could also be done by formatting the number with enough "d"s). Note: because 1 January 1900 was a Sunday, then by default, Sunday

is assumed to be the first day of the week, whilst Saturday is the 7th. By changing the return type, the start of the week can be altered to, say, Monday.

Defining time periods

Date series

Excel can help set up sensible date series as, for example, column headings. If a row of dates for the week commencing is required, the first two dates of the sequence are input. The fill method can be used to copy the series across the row.

- Select both cells
- Edit; Fill; Series
- Type; Date should be checked
- Step value 7
- OK.

Or select both cells, click and drag the little box (AutoFill handle) at the bottom right corner of the active range.

The same functionality can be used to put in month ends.

- Put in a month end and select area to put in month ends
- Edit; Fill; Series
- Date unit; Month should be checked
- Step value 1
- OK.

Alternatively, this can be done by typing in the date of the first month end and this time right click and drag the AutoFill handle.

If the start date is 31 January 2004 (say in cell D1), then to link other cells (to create more dates) to the start date can be done in a number of different ways:

1. =D1+365

   As all dates are numbers, and years are 365 days, this will generally work. In the above example, the result will be 30 January 2005 because 2004 is a leap year.

This method is good but not great.

2. =EDATE(D1,12)

   EDATE adds the full number of months (in this case 12) to the starting number. In the above example, the result will be the correct date, 31 January 2005.

79. =EOMONTH(D1,12)

   EOMONTH puts in the last day of the month specified (in this case 12 months later) after the starting month. In the above example, the result will be the correct date, 31 January 2005.

   This method always works – but is less useful if the month end is not the relevant date.

If monthly or quarterly dates are to be used, method 1 is not suitable but either method 2 or 3 can be used.

If the relevant date is to be, say, the 5th (of each month, quarter or year) then EDATE is the appropriate function.

If the month end is the relevant date then EOMONTH always works. By comparison, EDATE will always add on the relevant number of months from a given date - if quarterly dates are needed and the last day of February is to be used, then 3 months after that is 28 May rather than 31 May. The same issues can arise with other month ends as some months have 30 days and some 31.

Length of periods

As dates are numbers, then subtracting one date from another generates the number of days between the dates. Consequently, to count the number of days in a month, quarter or in fact between any 2 dates is easy.

The YEARFRAC function looks at the proportion of a year between 2 given dates:

=YEARFRAC(start_date,end_date,basis)

The basis should be one of the following, each giving a slightly different outcome:

0 or omitted	US (NASD) 30/360
1	Actual / actual

2	Actual/360
3	Actual/365
4	European 30/360

Note: the function only gives positive results and so care should be taken in ensuring that the start date is the earlier date as it will not be apparent from the output.

Consolidating time periods

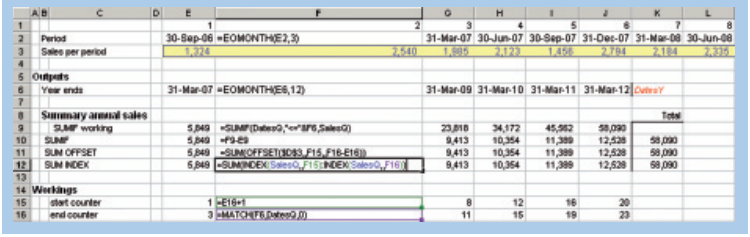
It is possible to consolidate monthly, quarterly or semi-annual workings into annuals. There are a number of fully flexible approaches to this, the most straightforward of which depends on the modeller and users' Excel proficiency and preferences.

The coding can be simplified by the use of range names. However, care must be taken when using range names when the model contains different time frames. For example, the data in column H may relate to a quarter in one part of the model, whilst referring to an annual period elsewhere. Range names such as DatesQ, SalesQ could be used to contrast with DatesY etc. to help identify quarterly and annual data so that only the appropriate ranges are used.

Illustration

The quarterly and annual dates have both been created using EOMONTH with 3 and 12 being the number of months respectively.

We are trying to sum the quarterly sales which fall between the year ends – note the first year is not a full 4 quarters.



	A	B	C	D	E	F	G	H	I	J	K	L
1					1	2	3	4	5	6	7	8
2			Period		30-Sep-06	=EOMONTH(E2,3)	31-Mar-07	30-Jun-07	30-Sep-07	31-Dec-07	31-Mar-08	30-Jun-08
3			Sales per period		1,324	2,540	1,885	2,123	1,456	2,784	2,184	2,335
4												
5			Outputs									
6			Year ends		31-Mar-07	=EOMONTH(E6,12)	31-Mar-09	31-Mar-10	31-Mar-11	31-Mar-12	DatesY	
7												
8			Summary annual sales								Total	
9			SUMIF working		5,849	=SUMIF(DatesQ,"<="&F6,SalesQ)	23,818	34,172	45,562	58,090		
10			SUMIF		5,849	=F9-E9	9,413	10,354	11,389	12,528	58,090	
11			SUM OFFSET		5,849	=SUM(OFFSET(3DS3,,F15,,F16-E16))	9,413	10,354	11,389	12,528	58,090	
12			SUM INDEX		5,849	=SUM(INDEX(SalesQ,,F15):INDEX(SalesQ,,F16))	9,413	10,354	11,389	12,528	58,090	
13												
14			Workings									
15			start counter		1	=E16+1	8	12	16	20		
16			end counter		3	=MATCH(F6,DatesQ,0)	11	15	19	23		

SUMIF

=SUMIF(range,criteria,sum_range)

The SUMIF function requires data (the range) to fulfil a criterion (criteria). If it does fulfil this requirement, then a corresponding set of data (sum_range) can be summed.

As dates are numbers (masquerading in a text format), the quarterly dates are the data which must be less than or equal to the annual date (which must be the criteria). Unfortunately, by default, the data must equal the criteria. It is only by adding the text string component ("<="&F6) to the criteria that we can get around this restriction within SUMIF.

Once the quarterly dates have been identified as being less than or equal to the respective year end, then the corresponding sales data to be summed must be chosen (from the same columns as the quarterly dates). As the criteria is to be less than or equal to the respective year end then the function will sum all sales up to that date. Consequently, a further line, which eliminates all previous year's sales, can be easily added to create only the relevant sales.

in F9 =SUMIF(DatesQ,"<="&DatesY,SalesQ)

or =SUMIF($E$2:$AA$2,"<="&F6,$E$3:$AA$3)

in F10 =F9-E9

SUM OFFSET

OFFSET can be used to identify a single cell or a range. For the latter, the address of the range is identified and then the contents summed. The trick is to identify the starting and finishing point of the range.

Preliminary step – period counters

In the above illustration, the first year's sales are for the first 3 quarters (i.e. the 1st to 3rd sales figures) and the second year is from the 4th to 7th figures, etc. The start and end point in the sales range can be identified in the following corkscrew:

- The end position within the range can be identified using the MATCH function to find the relevant year end in the range of quarterly dates (using the exact [0] matching criteria):

  in F16 =MATCH(DatesY,DatesQ,0), or

=MATCH(F6,$E$2:$AA$2,0)

- The start is merely 1 period after the previous ending period

in F15 =E16+1

The OFFSET

The OFFSET function identifies a cell or range which is a specified position away from a starter cell. The sales data is a 1-dimensional (1 row) range and so only the column and width criteria are required (together with the required starter cell). It is cleaner to use a cell outside the data area as the starter cell (in this case D3 – immediately to the left of the data to be summed) as the address of the target area is always offset a given number of cells from this point.

The OFFSET function then identifies the relevant range as starting so many columns (1, 4, 7 etc.) away from the starter cell (D3) and being 3, 4, 4 etc. cells wide (being the difference between the end position for the relevant year and that of the previous year). As a result, the OFFSET function has identified E3:G3 for year 1 and H3:K3 for year 2 etc. By placing a SUM around this range, the relevant consolidated sales is returned:

in F11 =SUM(OFFSET($D$3,,F15,,F16-E16))

SUM INDEX

INDEX can be used to identify, from within a specified data area, a cell value or address. For the latter, the addresses of the start and end of a range are identified and then the contents summed. As with OFFSET, the starting and finishing point of the range needs to be identified – done using the same preliminary step as for OFFSET.

Two similar INDEX functions are used to identify the addresses of the start and end of a range. As the sales data area is a 1-dimensional (1 row) range then only the sales data area and the start (or end) column number within this area need be identified.

In cell F15, the starter cell address is identified by =INDEX(SalesQ,,F15) where SalesQ is the sales data area and F15 indicates that the cell is in the 4th column of this data. On its own, the result of this function would be the sales in the 4th quarter. However, when combined with another function, Excel knows to use the address result instead. Similarly, the end cell address is identified by =INDEX(SalesQ,,F16).

By combining the results of the 2 INDEX functions a range can be identified and then placed within a SUM:

in F12 =SUM(INDEX(SalesQ,,F15):(SalesQ,,F16))

or =SUM(INDEX($E$3:$AA$3,,F15):INDEX($E$3:$AA$3,,F16))

Switches

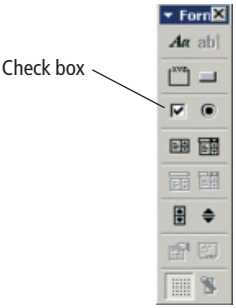
A switch can be created to allow a model to alternate between different sets of criteria. This allows Excel to model different potential outcomes.

For example, if the funding for the project / acquisition will be either 75% or 100% debt, then a switch can be used to highlight the 2 alternatives; or where Monte Carlo simulation is used so that the model shows either the expected or the Monte Carlo output results.

The Forms toolbar is used to create boxes and buttons which enable the user to quickly select between the various options. All items within the Forms toolbar are created and amended in the same way. The common theme is that the buttons / boxes all sit on top of the model and require some link between the model and the box / button through a cell link – a previously blank cell - which is then used to drive further equations.

Two-way switch

For example, to create a two-way switch:



- Open the Forms toolbar (View; Toolbars; Forms) or right click whilst on toolbar and select forms
- Select the Check Box, move the cursor onto the model where the check box is to appear (the cursor now becomes a crosshair) and create the check box by dragging with the left mouse button held down
- Using the right mouse button, click on the check box and select Format Control; Control; Cell Link (type or go to the cell reference for an unused cell)
- Click outside the check box to finish.

A ticked checkbox will return TRUE in the linked cell, whilst an un-ticked checkbox will result in FALSE in the linked cell.

An IF statement based on whether the switch is TRUE or FALSE can be used to alternate the model assumptions. When using the IF statement it is useful to name the linked cell containing the TRUE / FALSE statement.

For example, if the switch is to be used to alternate between equity accounting and proportional consolidation as the two options, then

=IF(Switch=TRUE,"Equity accounting","Proportional consolidation");

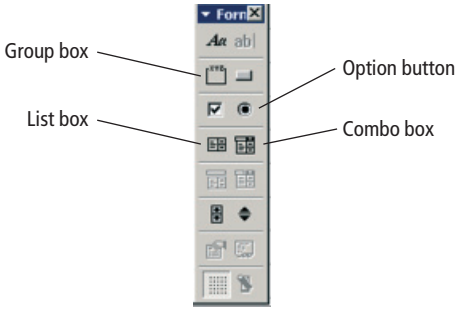
or, more simply

=IF(Switch,"Equity accounting","Proportional consolidation")

would change the cell text from equity accounting to proportional consolidation.

The check box can be formatted for colour, using the right mouse button, Format Control; Colours and Lines.

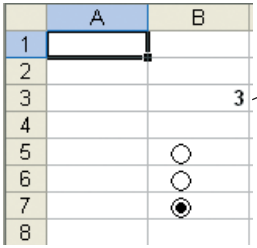
Multiple options



These buttons / boxes are created and amended and then linked to further formulae in the same way as the Check Box.

Option button

When an option button is created and linked to a cell (B3 below), 1 appears in the linked cell. If a further option button is created and clicked, the number 2 will appear in the linked cell, and so on. The number allocated to each option button is the order in which they are created (the first created is allocated value 1, the second value 2,…).



Here, three option buttons have been created. The three buttons will automatically be linked to the same linked cell (B3 in this case), unless a group box is used

The option button is useful where there are several different possibilities allowed. The linked cell could then be used with an embedded IF function (or a lookup function such as CHOOSE).

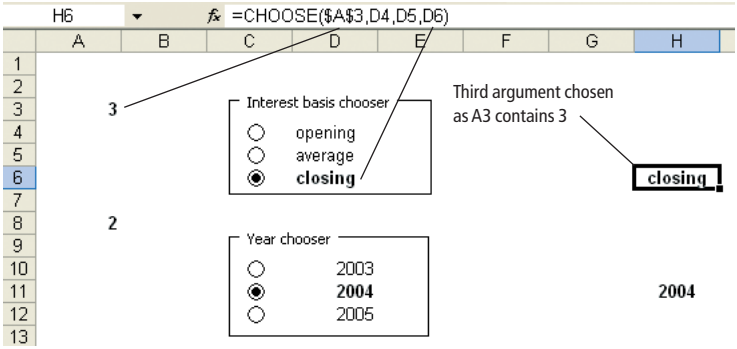
For example, if the calculation of interest on an overdraft balance could be performed on either the opening, average or closing balance, the following formula would generate the appropriate text.

=CHOOSE($B$3,“opening”,“average”,“closing”)

The CHOOSE function returns a value from a list of arguments, which could be text, references, calculations, etc. In the above formula, B3 returns a value between 1 and 3. If, say, option button 2 is chosen, then the formula would generate the result average.

Option button with group box

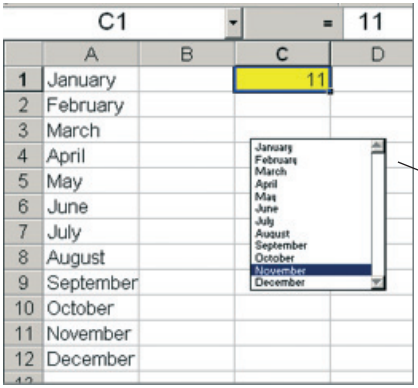
As more option buttons are created on the same sheet, they are automatically linked to the original linked cell. If more than one set of option buttons is required on the same sheet, it is necessary to use the group box.



In the above, two different sets of option buttons are being used to drive different scenarios. If the group box was not used, all the options buttons would have the same cell link (either A3 or A8) which would count between 1 and 6.

List box

The list box generates a drop-down list box. The item that is selected in the list box appears in the text box. The linked cell generates a number, being the numerical position of the selected item within the list.



Once in format control, enter the input range (in this example A1: A12) and the cell link (C1). If November is now selected, cell link shows 11, being the 11th item in the list

Combo box

The combo box works in broadly the same way as the list box, requiring the same inputs as the list box. The key difference is in the appearance – a drop-down box with the options will appear when the combo box is

selected; whilst only the item menu item selected will show when the box is not selected.

Formality

As we have seen, the boxes and buttons sit on top of the model and then are linked to the model by use of cell links (and extract data from the model, for combo and list boxes, through the input range). Consequently, they result in the cell link values changing as the different options are selected. Therefore, despite the user not physically using the keyboard to type in a hard-wired number (or TRUE / FALSE), the cell link changes.

The consequence of this is that all cell links MUST be situated on the Inputs sheet – the home of all other hard-wired inputs.

The switches should, therefore, also appear on the Inputs sheet as they are the way in which the user effects the change in the hard-wired cell link. However, this can be inconvenient. For example, if we wish to see the impact on the key outputs of changing an option, then we may wish to have the switches on the key workings / outputs sheet.

Switches can be copied – the key is to ensure that the cell link (and input range, if relevant) refers to the same cell in both locations. The result will be that the options can be changed simultaneously:

- On the input sheet using the switch
- On the workings / output sheet using the copied switch; or
- On the input sheet by changing the value in the cell link.

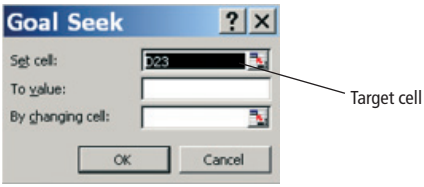
Sensitivity

Goal seek

Goal Seek is a simple but powerful sensitivity and testing tool. Goal Seek can be used for "break even" analysis and to answer many typical questions that would be asked of a model for example: 'how much growth is required in order to achieve the target return?'.

Goal Seek is very easy to use:

1. Select the cell containing the formula whose result you wish to calculate (in this case D23), then select Tools; Goal seek. The following dialogue box will be displayed:



2. In the second (To value) box enter the value you would like the Set cell to equal
3. In the third (By changing cell) box input the address of the cell containing the input you wish to vary. In the case of the question above it would be the cell containing the growth rate assumed in the model. This must be an input – it cannot be a formula
4. Press OK.

Excel will then vary the value in the input cell until the value in the target cell reaches the target value.

If the target cell is formatted to a number of decimal places, you will notice that Excel usually does not exactly hit the target. Excel stops the iteration process when it meets the target value set +/- the iteration limit set in the model. To change the iteration limit to get Excel to get closer to the target, go to Tools; Options; and select the Calculation tab. Set the iteration limit to an appropriate number of decimal places.

Goal Seek, like the Data Table tool which follows, is very powerful, but both rely on a simple set of single parameter inputs and key results. Both of these tools lend themselves very well to simple broad brush models. The more that inputs can be simplified, for example using a single interest rate, sales growth rate or inflation rate for the whole forecast, the more useful simple powerful tools like Goal Seek will be.

Data tables

Data Tables are sensitivity tables by another name and they are brilliant as they are highly effective tools in assessing which are the most sensitive inputs (i.e. have the greatest impact on outputs) of the model. Sadly they use up a lot of memory and so it is essential that the

- Tools; Options; Calculation tab.

is checked for a manual (F9) calculation (or automatic except tables). Otherwise, after each new entry anywhere on the model, Excel will try to

recalculate the table – which will take a particularly irritating amount of time.

The sensitivity table can look at variations of up to 2 variables. Unfortunately, Excel requires that the 2 variables are on the same sheet as the sensitivity table. It is likely, therefore, that the table will need to be on the input sheet (although the tables' contents can be referred to an output page for printing purposes).

To set up a data table to check the sensitivity of the Enterprise Value for changes in the EBITDA exit multiple and equity discount rate, the following steps must be followed:

1. Select the value upon which the sensitivity is to be performed (the Enterprise Value) and place the reference for this in the cell to the top left hand corner of the table
2. Choose the inputs to be varied (e.g. EBITDA exit multiple and equity discount rate) and input a series of values in the row across the top of the table (e.g. EBITDA exit multiple) and a series down the left hand column of the table (e.g. equity discount rate). Note: these series of inputs must NOT be linked to the inputs that you are looking to vary
3. The ranges in the top row and left column are generally driven from the centre values (7.0 and 13.0% respectively in the following illustration) with equal increments from this centre value
4. Highlight all the entries thus made which will, therefore, require a rectangular table to be highlighted
5. Using the

   • Data; Table function

   The row input cell reference (being the input varying across the top row of the table) – will be the input for EBITDA exit multiple which drives the rest of the model; and

   Column input cell (being the input varying in the left column of the table) – will be the input for equity discount rate which drives the rest of the model.

6. Using

   • F9

   A data table will be produced which highlights the sensitivity of the Enterprise Value to the changing EBITDA exit multiple and varying equity discount rate.

Enterprise Value – £m sensitivity

		EBITDA exit multiple				
Equity discount rate	147.7	5.0	6.0	7.0	8.0	9.0
	12.0%	133.0	143.7	154.3	165.0	175.7
	12.5%	130.2	140.6	151.0	161.4	171.7
	13.0%	127.5	137.6	147.7	157.8	167.9
	13.5%	124.8	134.7	144.5	154.4	164.2
	14.0%	122.3	131.8	141.4	151.0	160.6

In the above table, the model output for Enterprise Value is £147.7m with an EBITDA exit multiple of 7.0x and equity discount rate of 13.0%. This is the value at the centre of the sensitivity table and in the top left corner.

If the EBITDA exit multiple were to be 5.0x and the equity discount rate became 13.5%, on the assumption that all other inputs remained unchanged, then the Enterprise Value would be £124.8m – i.e. £22.9m of value has been destroyed.

Making the table more flexible

To make tables more flexible and more useful to review, it is sensible for the middle of the series of values across the top of the table (7.0 above) and the middle of the series of values down the left hand side (13.0% above) to be equal to the actual inputs in the model.

However as said above, the table will not work if these are linked to the actual inputs.

Therefore a sensitivity range schedule can be set up as follows;

	Link to actual inputs	This is middle value	Incremental change
EBITDA exit multiple (x)	7.00	7.00	1.00
Equity discount rate	13.0%	13.00%	0.50%

The first column is directly linked to the actual inputs. The second and third columns are entered as hard numbers.

- The number **input** in the second column must be the same value as that in the first column (but not linked). It is this cell which is linked into the centre of the top row / left column of the sensitivity table
- The values either side of the middle values can be controlled by setting the increment (in the third column) by which the values should increase or decrease.

Error diagnostics

Often the model works in the way it should and the user concentrates on the key outputs. Sometimes, however, due to changes made to inputs, the sensitivity tables do not represent the values appearing in the rest of the model. Sadly, this is often only spotted once the model has been printed.

Error messages can be used to flag up problems with sensitivity tables. These errors are of two types:

1. When inappropriate values are being input into the top rows / left columns of the tables which do not coincide with those of the inputs used in the rest of the model.

   By setting up a sensitivity range table (as above), the values in column 1 (based on the numbers driving the rest of the model) and column 2 (used to drive the sensitivity tables) can be compared. Any differences should be flagged and all differences summed.

   An error message can be driven from this sum of the differences.

2. The sensitivity tables may not have recalculated as F9 may not have been pressed.

   When the sensitivity tables are working, the value in the centre of the table and that in the top left corner should be the same. The user can be

alerted to press F9 by comparing these two numbers and driving an error message if they do not agree.

Validating data

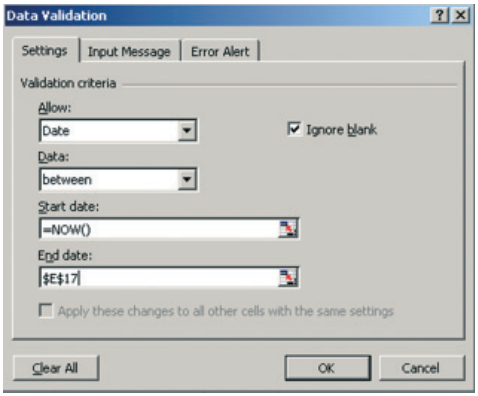
A major problem of financial modelling is controlling the quality of inputs and the results. Data validation is tremendously useful because it enables data entry to be limited, cell by cell, within a model.

Data validation – with inputs

Where the cell is an input cell, invalid inputs will not be allowed (and a prompt will indicate why). This is particularly useful if dates, currencies or text are to be entered in a precise format or to ensure that an input is within an allowable range.

For example, assume that only a date lying between today and the next year end (which is in cell E17) can be chosen.

- Select Data; Validation

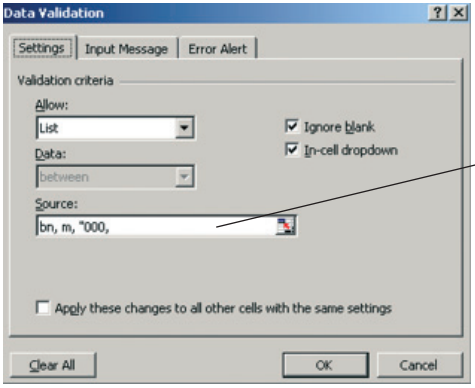


- Click on the down arrow by the Allow box and a list of options will be displayed
- Allow Date, between, and then either enter the start and end date or link to dates within the model.

This above Allow list shows the different ways in which the inputs can be constrained, e.g. whole numbers only, dates, values from a list and so on.

The Data box gives a series of choices for limiting the data (between, not between, greater than etc.) once a category has been chosen. The illustration shows the relevant entries to constrain date entry to the range described above.

If it is necessary to control the denomination entered to, say, bn, m, or '000, Select Data; Validation; select List – either enter the data as shown below in the source box or put the source data somewhere within the Excel model and then click on the arrow and highlight the area where the source data is entered.



This source can be typed in as shown. Alternatively select the area on the **same** sheet where the source data is located. If the source data is on another sheet, then the source data **must** be **named**.

Note. As shown, if the source data is on another sheet, then it is necessary to name the source data.

Input message

Input messages can appear at the same time as the cell when data validation is selected. There is no other visual indication in the worksheet that validation is in use. This should give instructions as to what to enter in the cell.

Where a dropdown (list) box has been chosen in the settings it is unlikely that an input message will be necessary.

However, where the user has to enter, for example, a forecast date, then by selecting the Input Message tab, a message can be composed so that the following instruction will appear:

> "The forecast date entered must be within the next 12 months"

Error alert

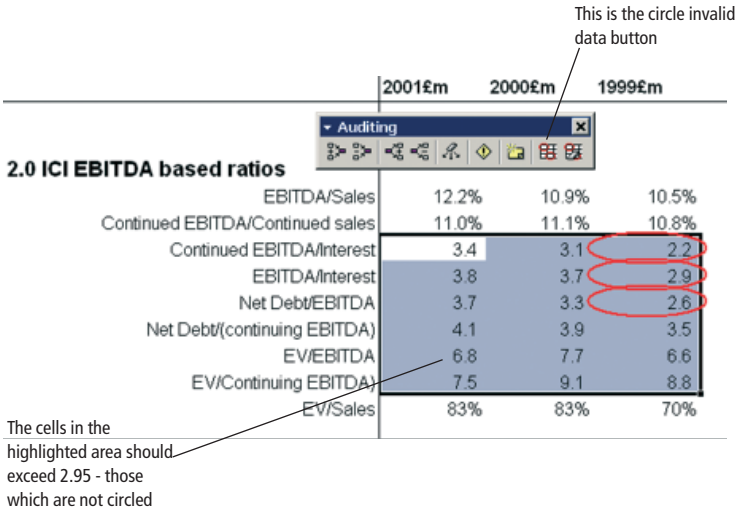
Data validation is best used to make inputting easy and to ensure robust inputs drive the model. It is imperative that inappropriate inputs are blocked – which is what data validation does.

When entries are blocked the following default message appears:

As this does not indicate how to solve the problem, it is useful to change the message. By selecting the Error Alert tab, a message can be composed so that the above message is replaced by "Must enter a forecast date within the next 12 months".

Data validation – with outputs

Additionally, data validation of outputs can be used to "sense check" results: If we apply data validation to a range of cells containing formulae, Excel will not stop the results of the formulae from being outside the required range, but if the "Circle Invalid Data" button is pressed on the Auditing toolbar, then cells with results outside the required range will be highlighted:



Conditional formatting

Conditional formats can be used to validate results. For example, conditionally format so that those cells which are not valid / do not fulfil the benchmark criteria appear as a different colour, with borders, with a coloured background, etc.

The advantage of this is that the problems are highlighted without the use of other functions (i.e. the auditing toolbar for data validation above).

The disadvantage of this method is that these cells are merely formatted without having any other functional implication – i.e. the fact that a cell fails a test does not prevent that cell from being used elsewhere.

Conditional statements

The use of flags (0 and 1) through IF statements can add functionality if the result of an equation is not valid / does not meet the benchmark criteria.

If, for example, a project has to fulfil 4 out of 5 criteria to get funding then conditional formatting and data validation can still be used to identify whether the benchmarks have been reached on each criteria.

However, to indicate that some of the inputs need to be changed as they do not fulfil 4 criteria, a series of IF statements with 1 or 0 as the values if TRUE or FALSE respectively can be added. If the sum of these statements is greater

than 1 then the tests have failed (and so a message stating that inputs should be changed should appear). If the sum comes to 1 or less then the project can get the funding.

The ISERROR function

It can be irritating when #DIV/0! appears in a cell, not because a genuine error has been made but because one of its precedents has not yet been completed. It then has a knock-on effect to all the current cell's dependents, so making the model ugly.

This function effectively eliminates errors from the formula and also stops its spread to any of its dependents.

For example:

> If the contents of A1 were 187; A2 were 0; and those of A3 were =A1/A2 the result would be #DIV/0!.

By amending the formula in A3 to:

> =ISERROR(A1/A2)

the result would be TRUE (i.e. there has been an error).

This has its uses, but could be made more useful by adding a logical test to the function:

> =IF(ISERROR(A1/A2),0,A1/A2)

The result being 0 this time rather than TRUE.

Note: the ISERROR function should be used with care. Sometimes when an error occurs it is because something has gone wrong with the model. This error needs to be fixed. The ISERROR function will cover up any errors and so can undermine the controls put in the model.

Model completion

Group outline

When printing or presenting the model, there may be parts of the model which you do not want to print – e.g. historic periods, detailed calculations for check balances etc. In this case, the relevant rows or columns can be hidden:

- Select the column(s) or row(s)
- Right mouse
- Hide.

This is quick, but is shoddy practice:

- It is not always obvious that columns or rows are hidden
  - Why are they hidden?
  - Do they have any effect on any other parts of the model?
  - Do they contain fixes for the rest of the model...?

There may be perfectly good reasons for doing it but many users would be suspicious as it is seen as a way to hide things that are suspicious.

A far better way is to:

- Select a cell(s) in the relevant column(s) or row(s)
- Data; Group and Outline; Group – Alt-D-G-G
- Select either rows or columns.

The selected area can now be hidden but with the use of a column or row bar (to the top or left hand side of the window respectively). If the bar outline symbol is "+" then the user can click this to show the hidden area. If the "-" symbol appears in the outline bar then a defined area can be hidden.

Protecting the model

Once the model is complete and everything works, then it is worth protecting the model to ensure the modeller (or the reviewer) does not amend the formulae and corrupt the hard work done to date.

It is unlikely that the inputs and assumptions should be protected, but all other sheets are formula-driven and these are the ones that need protecting.

Note: If report manager is used, at least one sheet must remain unprotected in order to allow report manager to be activated.

Whole sheets can be protected by:

- Tools; Protection; Protect sheet. Leave the default boxes in the dialogue box ticked
- The use of a password is optional – without a good reason, it is sensible not to use one, unless the modeller wants to be contacted at any time of the day or night by any subsequent user for the rest of the model's life!

Selective protection

The default setting within Excel is that all cells will be protected when a sheet is protected.

To protect a sheet, but allow some specific cells to be changed, then cells and ranges can be "selectively unprotected" using the following procedure (note: this will only work if the sheet is unprotected first):

- Highlight the cells which you want to be able to amend
- Format; Cells; Protection, untick the "Locked" box. Press OK
- Protect the sheet (as above).

This creates "windows" in the locked sheet where the model can be manipulated. This is useful for the inputs sheet where the text is protected but the actual inputs can be changed.

Styles and protection

Selective protection can be done through the use of Styles. The last of the Style options is "Protection". All input styles should have this box checked and then modified (protection – locked box is NOT checked) to be "No protection".

As the default setting for cells is to be Locked when the sheet is protected, by leaving the "Protection" style option unticked for all other styles, the result will be that only those cells with the input style can be changed once the sheet is protected

Hiding

If you wish to hide all (or some) of the formulae and only allow the user to have access to the results of the cell(s), ensure the sheet is unprotected and then:

- Select the sheet – Control+A
- Format; Cells; Protection, tick the "Hidden" box. Press OK
- Protect the sheet (as above).

What you have created is a sheet which looks the same, but is protected and the user cannot see the formulae that underlie each cell.

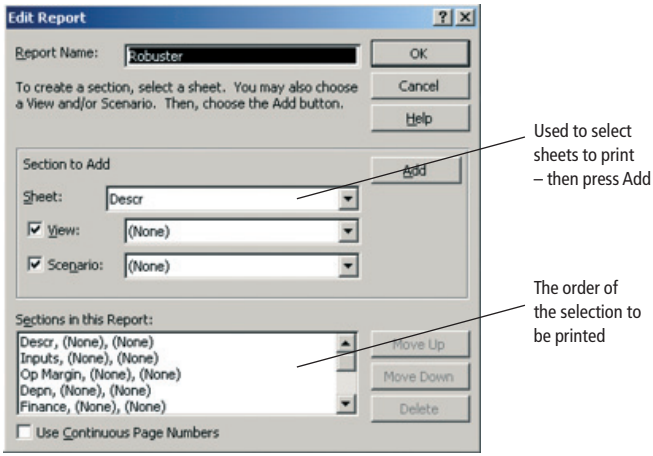
Report manager

Report manager (one of the Excel add-ins) is Excel's built-in print macro – it allows reports to be created and saved, and hence printed out whenever required.

- View (if report manager has been added from Tools, Add-Ins), Report Manager.

Click on the sheets to be included and click Add. This must be done one at a time. Further down the box the sections entered in the report are shown. If the order needs to be changed or something deleted, buttons allow this.

It is essential that each sheet (and pages within sheets) is set up (as regards margins, page breaks etc.) separately as report manager will then pick up the specific way each sheet is set up. This should have been done when the model was set-up originally.



Note: In order to activate the report manager, the sheet in use must be unprotected (although the sheets which are to be printed need not be).

Tracking editing changes

The track changes function will provide a clear trail of amendments made to a model from a specified date using comment boxes. The comment will detail the nature of the change, the date and its time.

For example:

- Tools; Track Changes; Highlight changes
- Tick checkbox for track changes while editing.

Excel will save a temporary file – maintaining a record of the model pre changes.

Any editing changes made will be noted in a comment box providing a full trail of amendments.

To subsequently accept or reject the changes:

- Tools; Track changes; Accept or reject changes (Excel will save a temporary file maintaining a record of all changes made)
- Select changes to Accept or Reject; OK
- Review proposed changes selecting from the menu whether to accept or reject changes.

Once the work has been reviewed, the original model can be updated with the reviewed changes by:

- Tools; Merge workbooks

To switch off the track changes function:

- Tools; Track changes; Highlight changes
- Remove tick checkbox for track changes while editing.

This function is also very useful when making changes to or reviewing somebody else's model to explain or provide detail about the amendments.

Historic financials

Decide which historics are necessary – i.e. income statement, cash flow statement and balance sheet.

Inputs should go on the inputs page, but historics are facts rather than assumptions driving future results or value and so it is reasonable to put them on the appropriate sheets (i.e. income statement historics on IS sheet, etc.).

Think about the structure of the financials.

- Decide on which headings are necessary in each – for example, in an income statement it may be Sales, EBITDA, EBIT and net income with all other numbers being of limited interest to the output
- Alternatively, a detailed income statement might be deemed necessary for the required output. Here the limit may be the level of detail in the historic financials, or more likely, by the level of detail in the forecast assumptions available (e.g. from brokers or management)
- In the balance sheet, a detailed breakdown is lovely, but realistically, it is often only the capital structure that is necessary for most outputs – many of the other categories can be combined.

The income statement

Put in the necessary headings – and the other figures between these are "noise" to make the statements reconcile.

Ensure that the bottom line figure ties in with the source – and put in a check to ensure this.

It will be necessary to tie some of these numbers into the other financials – a profit figure (one of EBITDA, EBIT or net income depending on preference) to start the cash flow and the cumulative reserves (or equity) for the balance sheet (see below).

The cash flow

Put in the necessary headings (probably operating cash flow and pre-financing cash flow) and the other figures between these are "noise" to make the statements reconcile.

The starting point for the operating cash flow is likely to have been fed from the income statement sheet (one of EBITDA, EBIT or net income depending on preference).

Ensure that the bottom line figure ties in with the source and put in a check to ensure this.

It will be necessary to tie the cumulative cash (or net debt) into the balance sheet (see below).

The balance sheet

Put in the necessary headings (probably capital structure, PPE and working capital) and the other figures between these are "noise" to make the statements reconcile.

The source for the equity (or retained earnings) should come from the income statement sheet:

On the income statement sheet, reconcile the bottom line to the equity (or retained earnings) from the balance sheet using:

Start of year	X
Net income	X
Less: Dividends	(X)
Other additions (deductions)	X
End of year	X

The category "Other" should be explainable (e.g. equity raised, other recognised gains or losses), but some adjustments may not always be laid out in the source.

The source for debt, cash or net debt should come from the cash flow sheet:

On the cash flow sheet, reconcile the bottom line to the net debt (or cash) from the balance sheet using:

Start of year	X
Cash flow (pre net debt flows for net debt reconciliation)	X
Other additions (deductions) – e.g. foreign exchange	X
End of year	X

The category "Other" should be explainable, but some adjustments may not always be laid out in the source.

Put in some checks to ensure that the balance sheet balances and put the result on the Checks sheet.

The historic balance sheet from the source will always balance and so must the balance sheet in the model before moving on – and this should be done without the need for a "fudge" figure.

Forecast financials

To make life easier, the first step must be to get the forecast balance sheet to balance.

Ensuring balancing balance sheets

This is done by:

1. Filling in all the totals and subtotals in all the forecast financial statements (including the retained earnings / equity and cash / net debt reconciliations together with the balance sheet check calculations).

   If the historic financial statements have been set up correctly, then all these formulae can be copied from the historics.

   In order to ensure that the forecast financials continue to integrate, the retained earnings / equity will be fed from the retained earnings / equity reconciliation in the income statement workings and the cash / net debt from the cash / net debt reconciliation. As profits are inserted into the forecast income statement and cash flows into the cash flows statement then the balance sheet will update. On setting these up in the forecast periods, there will, initially, be no movement.

2. The balance sheet will not currently balance. By linking each value in the balance sheet (other than retained earnings / equity and cash / net debt) to the value in the previous year, the balance sheet should initially balance (at the same value as the last historic year).

3. All movements in other categories within the balance sheet will be updated on a module by module basis.

   For example, if capex is forecast, formulae should be updated to accommodate this - capex will reduce cash in the cash flow and increase assets in the balance sheet.

   When adding the results of the forecast workings, the financial statements should then automatically update and any errors will immediately be revealed through the checks you put in earlier – if they do not, you should not move on.

The objective is to create all the individual lines which will make up the income statement, cash flow and balance sheet. The usual minimum requirements in terms of the number of modules is three and the components are as follows:

a) **Operations and working capital**

- Sales
- EBITDA margin
- Working capital balances

b) **PPE / fixed assets**

- Net book value
- Annual depreciation charge
- Aggregate annual capital expenditure

c) **Debt**

- Closing debt balances
- Interest costs
- Fees payable
- Aggregate drawdown and repayment assumptions
- Repayments of overdrafts or revolving credits from free cash flow.

Error identification

After each module, the outputs from the workings should be tied into the financials, so creating a balancing balance sheet at each stage of building up the model. For example, if the balance sheet does not balance after processing the operations and working capital numbers, then the error must have occurred in that module and so the error should be easier to track.

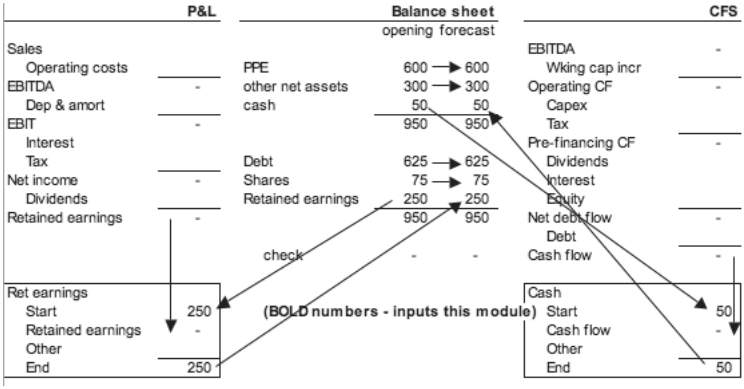
Find the difference in the balance sheet in the first period of imbalance.

- If the difference is recognisable – error of omission – the entry has not been entered in all the appropriate places
- If the difference ÷ 2 is recognisable – the entry has been made but added rather than taken away or vice versa.

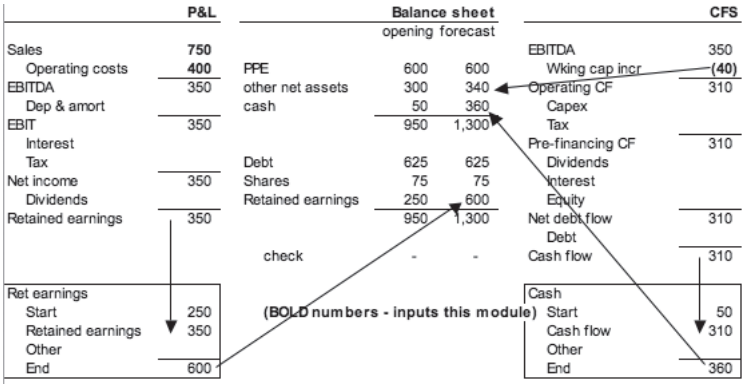
For example, to tie in the operations and working capital numbers:

Sales, operating costs (excl. depreciation & amortisation) & EBITDA	IS
Working capital increase (add to appropriate brought forward figure)	BS
EBITDA & working capital increase	CFS

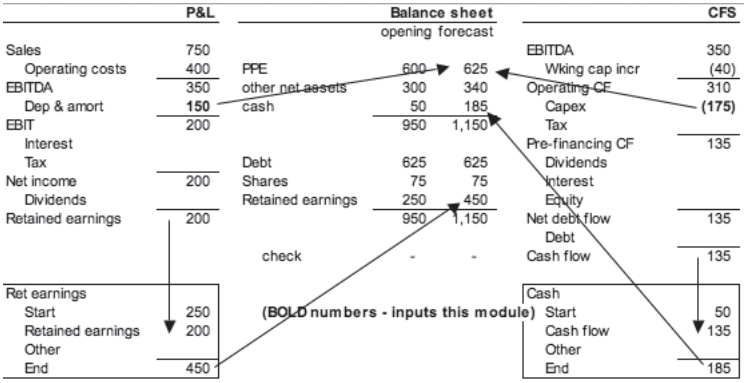
Setting up the reconciliation



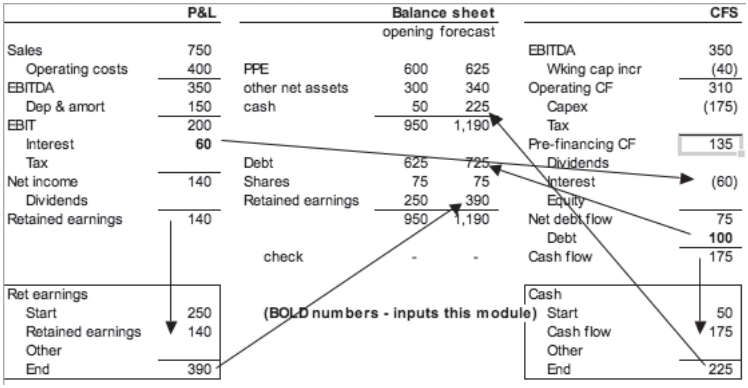
Operations and working capital



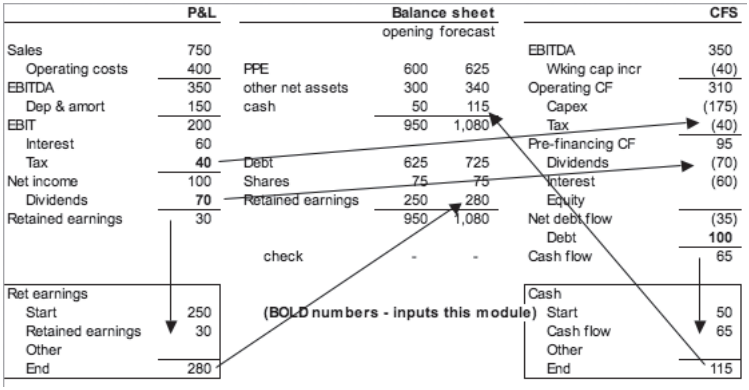
PPE



Debt and interest



Tax and dividends



Debt modelling

The big problem when modelling debt is the ease with which circularities can be created. As a model is a simplification of the world, then the circularity problem can be circumvented by use of appropriate simplifying assumptions.

The problem

Tax is often calculated using the following:

EBITDA	X
Depreciation (tax based)	(X)
Net interest expense	(X)
Taxable profit	X

Net interest expense is interest on debt less (add) interest on cash (revolver) respectively.

Interest on cash / revolver balances is calculated using the following:

Opening cash (revolver) balance	X
Cash increase / (decrease) in year	X
Cash (revolver) at end of year	X

Cash increase in the year is a post-tax, post-interest figure and so, therefore, is the cash at the end of the year. Consequently,

- The tax expense is dependent on interest on cash and
- Interest on cash is dependent on both tax expense and interest on cash

i.e. a circularity has been created.

A solution

(Assumption: the debt instruments have a structured repayment profile and any shortfalls or spare cash goes to the cash / revolver)

1. Build up the individual debt schedules with structured repayments
2. Calculate the interest arising on debt instruments
3. Set up the cash / revolver schedule as:

Opening cash (revolver) balance	X
Cash increase / (decrease) in year (leave blank for now)	
Cash (revolver) at end of year (opening +/- increase / (decrease))	X

4. Calculate interest on cash / revolver based on OPENING balance (to avoid circularity)
5. Sum up all interest to find net interest expense
6. Do tax working (including the net interest from above)
7. Put tax expense into both the P&L and the cash flow (and balance sheet if it is not all to be paid in the year)
8. Fill in the "Cash increase / (decrease) in year" line above as

Net debt decrease (increase) in year	X
Scheduled debt repayments	(X)
Cash increase / (decrease) in year	X

Where net debt decrease (increase) in the year is the post-tax (but not yet post interest) cash flow.

9. All the debt (and cash) and interest information is now calculated and so can be put into the financial statements
10. Put a check to ensure that the net debt (or cash) from the debt sheet equates to that in the balance sheet (which already equates to that in the cash flow).

The interest on cash / revolver uses a simplifying assumption to get around the circularity problem. However, if there are significant movements in cash then the interest may not be accurate enough.

In this case it would be useful to build a switch which would vary the way the interest was calculated:

- If the switch was on, interest would be calculated on average balance (and hence circularity)
- If it were off, then interest would be calculated on opening balance (no circularity).

The settings should be set to allow iteration in the calculations (Tools, Options, Calculation, Iteration). The model will work but is less stable

– and so the switch should be on only when there are few amendments left to be made to the model in order to avoid the model crashing.

Auditing and error detection tools

Error values

#VALUE!

This error has two common causes:

1. Referencing a cell that contains text. Select the cell with the error and press F2 or Control+[. Inspect the precedents and correct as necessary
2. Referencing a range instead of a single cell, for example, =E10+(E12:E20). In this case SUM is required.

#REF!

This error is commonly found when rows or columns are deleted from the model, such that a formula refers to a cell which no longer exists.

#NAME?

This indicates that Excel does not recognise the range name entered in the formula.

#DIV/0!

This error often occurs either when data is being deleted from a model, or when formulae are written in advance of the information being provided. The denominator is missing or is 0.

#NUM!

This usually occurs with the IRR function. If it cannot generate an answer within 20 iterations when calculating IRR it returns the #NUM! error.

#N/A

This is often generated by VLOOKUP, HLOOKUP and MATCH type functions, often because no exact match for them can be found.

Auditing a formula

F2

The F2 button, when on a cell, edits a formula. Excel will highlight the cells in coloured boxes which are precedents of the cell that is being edited. Consequently, F2 is the quickest way to audit a formula when the precedents are located close to the formula, but of limited use when they are elsewhere.

If more information about the cell is needed, press F2 to inspect the formula and then select one of the cell references. If F9 is then pressed the reference converts to the value of the precedent cell. This can be repeated until all cell references are converted to values. Do not press Enter, otherwise the references are permanently converted to values. If this technique is used with range names, Excel will treat the name as an array reference and on pressing F9 will return every value in the array!

Control+[

Control+[	Goes to all the precedent cells on the same sheet (goes to first precedent only if on different sheets)
Control+]	Dependent cells (on same sheet only)

F5

When the precedents are elsewhere in the model, highlighting the cell reference or name in the formula and pressing F5 (the Go To command) will go to the relevant cell (or range). Unfortunately each component of the equation needs to be done in isolation.

Often the best use of this function is when switching between 2 parts of the model. By going to a cell (possibly by using the auditing toolbar or Control-[), F5-Enter will return you to the original cell.

Auditing toolbar

The auditing toolbar is a powerful tool and should form part of the main toolbar for any Excel user. It can be used to:

- Trace all the ***precedents*** of a cell (and their precedents, and their precedents … if needed) in order to find what a cell is dependent upon

This is particularly useful for identifying where the coding has gone wrong (a negative has been formed when it should not have been, or worse a #REF! or #DIV/0!) or when you are trying to follow someone else's model.

- Trace all the ***dependents*** of a cell (and their dependents …) in order to find what effect the cell has elsewhere

  Particularly useful for finding out if, by the end of model, a cell is not referred to something. If this is the case, it is either an output or rubbish. The tool is also useful for finding out why a cell is used when picking up someone else's model.

- Trace ***errors***. Where a cell has an error in it (such as #VALUE! or #NAME!), the use of this function selects the cell that contains the original formula that has an error and has all that cell's direct precedents arrowed.

Double clicking on the trace precedents / dependents tool will show both direct and the next indirect precedent / dependent.

Double clicking on the arrows takes the cursor to the end of the arrow.

Where an arrow points to another sheet, double click on the dotted arrow which then returns the relevant locations in the Go To dialogue box.

Summary

Order		Pros	Cons
1. F2	Highlights precedents	Quickest when precedents are near	Only useful if precedents are near
2. Control+[	Go to precedents	Quick	Only goes to first precedent on other sheets
3. Auditing toolbar	Traces precedents	Easy visual reference Double clicking on precedent line takes you to other end of line	Requires significant mouse action
4. F5	Go to precedents	Can go to specified precedents Better as a way to get back to original cell	Only goes to one precedent at a time Requires significant mouse action

Additionally, if names have been used:

5. The name means something to the reviewer
6. Name (drop-down) box – top left of spreadsheet – can be used to go to the named cell / range
7. F5 (all names are listed) – can be used to go to the named cell / range

Finding links

For reviewing a model from a third party or for modellers trying to fix their own models, locating and understanding the links is very important. Excel does not have any built in tools to help, but this can be easily done: Firstly, to find the name of any linked files, open the Edit menu and select Links. A dialogue box will be displayed showing the names of linked files and allowing the links to be updated.

The address of the linked cell(s) will appear as

='[Big and Clever.xls]Input'!$P$134

Finding the cells containing links in the workbook requires the following method:

1. Go to the first sheet in the model, go to the Edit menu and select Find
2. As the [is a bit of a give away in the above address, insert a square bracket, [, into the find box and press return. Excel will take the cursor to the first linked cell in the sheet and further linked cells can be found by pressing the find next button in the Find dialogue box.

The shortcoming of this method is that it is laborious: if there are a lot of links in a sheet this process can take a long time and Excel will only reliably search to find links if searching sheet by sheet.

Contained in old names

A source of spurious links is the copying of data between models where the copied cells use a range name. This can lead to a range name being included in the list of range names in a workbook, where the cells in that range are in another workbook. These can be found by going to the Insert menu and selecting Name and Define (or Ctrl+F3). Selection of the names in the list one by one will show up any ranges defined in other workbooks.

The F5 Special

The Go To Special is a very powerful auditing and orientation tool.

It can be activated by

- Selecting a single cell for most of the options in which case the whole sheet is searched (not possible for Row and Column differences)
- Selecting an area in which case only the selection is searched; or
- Highlighting the whole sheet in which case the whole sheet is searched (very useful for Row and Column differences).

When the cell or area is selected:

- Press F5 and then Special

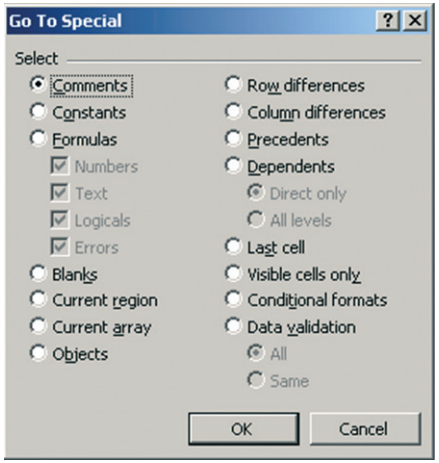
and then the following box appears:

Finds what

Both can be further specified by using the 4 sub-categories - for example, will go to a constant or formula result that is a number or text, etc.

All cells with comments
Any single inputs
Any result of a formulae

All empty cells (but not "" cells)
Same as Ctrl-*
The array containing the cell though not named range
Any pictures / objects



Finds what

Inconsistent formulae across a row
Inconsistent formulae down a column
Direct precedents
Direct dependents (Unless All levels chosen below), current sheet only

Same as Ctrl-End
All non-hidden cells – for formatting or chart source
Cells with conditional formatting
Any (or specified) data validation

Auditing for consistency over columns

A good model should have the contents of column E (assuming this is the first period of data) copied to each subsequent column on all sheets (other than inputs, of course). This will ensure that each period is calculated consistently and that the same assumptions are being used in each period.

The F5 Special function can highlight rows where there are inconsistencies across the periods.

- Select the appropriate columns (probably from column E to the end period)
- F5 (Go To)
- Special
- Row differences.

The inconsistent rows are highlighted for further investigation. To move between the differences use the Tab function.

(If there are inconsistencies which are quite spread out, then whilst they are highlighted, fill the selected cells with a colour so that it is easy to identify the inconsistencies. Each inconsistency can then be examined individually.)

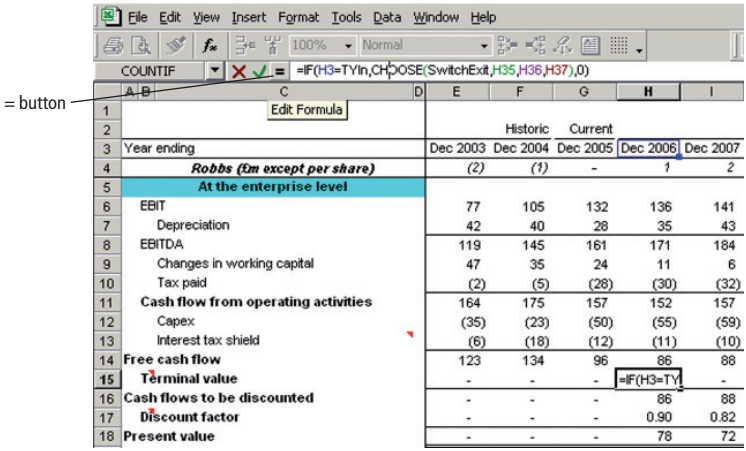
Other auditing tips

Unknown functions

If a formula contains a function which needs some explanation, by pressing the "=" button (edit formula, immediately to the left of the formula bar [fx button in Excel 2003]) when editing the formula, Excel will bring up the dialogue box for that function.

In the following, as the CHOOSE function is selected from within the IF statement (cursor flashing on that part of the equation), then the dialogue box for CHOOSE will be shown.

Alternatively Shift F3 can be used to put functions back into their dialogue boxes.



Alt-Return

Although formulae should never be long and complicated, occasionally someone else's model has these features. When auditing the formula it is useful to break it down. For example, the following formula has no complex functions but is not easy to decipher:

=-((PP/(PP+'Inputs & Results'!$F$25+AStart))*((SUM(F76:F81)+SUM(F84:F93))*(1-tax)- (Crate_monthly *Cstart*(F29/F30))))/(1-((PP/(PP+ 'Inputs & Results'!$F$25+AStart)*tax)))

By pressing Alt-Return at the appropriate breaks in the formula, the formula will read as:

=-(

(PP/(PP+'Inputs & Results'!$F$25+AStart))

*(

(SUM(F76:F81)+SUM(F84:F93))

*(1-tax)-

(Crate_monthly *Cstart*(F29/F30))

)

)

/(1-((PP/(PP+ 'Inputs & Results'!$F$25+AStart)*tax)))

The formula will remain in this form for subsequent users.

Auditing a model – a process

Upon opening

- Does it contain macros (message when opening re. enable / disable macros)?
- Does it have links to other models?

  Message on opening states "The workbook you opened contains links to information in another workbook. Do you want to update …"

  It is unlikely that you will be able to update the links as the file path of the linked file(s) are likely to be different to your path.

  To find the links, select all sheets and

  Control F (find)

  In the dialogue box window for "Find what" type [
  (all references to file locations have square brackets)

  Alternatively, on the bottom of one of the sheets

  F3

  Paste List

  Review the addresses of the names for any that have links to other models
- What size is it?

  File, Properties, General
- Are the sheets protected?

  Tools, Protection

  and then one of the options available is Unprotect sheet (alternatively, have the protection icon in the toolbar – it will state "Unprotect sheet" if the sheet is protected)
- Are there any hidden sheets?

  Format, Sheet

  And then one of the options available is Unhide

Coding clarity index

The coding clarity index is a scoring system to quickly assess the quality of the code in a model.

The purpose of the index is to give an "objective", or at least independent, basis for assessing quality in the model and give a guide as to the ease with which the model will be audited. Using the index is very simple.

1. Choose 50-60 lines of code in total from 3-4 different areas in the forecasts and review the code
2. Review the whole model to get a feel for the layout and structure and review any documentation, help or notes that come with it
3. Review the questions in the questionnaire and score the model. If the answer to the question has a score against it, score the relevant marks for that question. It does not matter how many times or how few times the design problem has occurred
4. Add up the scores and look up the score in the results table.

Coding clarity questionnaire

		Score for a yes	Score for a no	Model score
1.	Are any numbers hard coded or embedded into formulae? Even just for the conversion of units?	5		
2.	Are formulae inconsistent across the rows in the forecast area?	5		
3.	Are assumptions spread around the various schedules of the model and not in a separate assumptions sheet or sheets?	3		
4.	Are inputs colour coded?		1	
5.	Are complex formulae used where more than 2 formulae are nested inside each other?	1		
6.	Is switching done by multiplying formulae by statements like (c3=1), instead of using an If statement?	1		
7.	Are complex formulae annotated with "post-it" notes or clear labels or explained in model documentation?		1	
8.	Are dynamic labels used if relevant?		1	
9.	Are data tables annotated?		1	
10.	Are range names used for key assumptions?		1	
11.	Does the model have diagnostic calculations to flag inconsistencies?		1	
12.	Does the model have documentation, User instructions or Help?		2	
			Total	

Coding clarity results table

Score	Conclusion
0-6	This is a good score, and the model should be straightforward, clear and simple. As a general rule, this is easy to achieve in simple small models but more difficult as models grow.
7-10	This score should be readily achievable in most models and is a reasonable level to set as a minimum quality standard. It is important to consider when reviewing scores to see if a score in this range has been achieved without answering yes to question 1 or 2. These are much higher scoring than the other questions because the implication of them is poor discipline and structure. If these are the problem, then they should be resolved before the model is used.
11 & above	The model will have scored on question 1 or 2 and on most of the other questions too. This suggests that the model has been put together in a hurry or that the design scope has changed as the model has developed. It also suggests that the discipline and structure, which ensure quality, are missing. The obvious quick test of quality on a model like this is to look at the balance sheet and whether it balances. Whilst the model may appear alright now, it is unlikely to have a clear structure and is likely to have hidden implicit assumptions not explained in notes. It will be difficult to work with and develop later if it is not "polished" now. There will be big concerns about the internal consistency of the model and of its ability to produce sensible representative forecasts. It will be very difficult to be confident as to what the shortcomings and approximations are which will affect how the model's results will change as it is sensitised.

Troubleshooting

The steps for spotting errors in models:

1. Find and correct errors

Find and correct the original source of any of the following (i.e. the location of where the original problem started), by use of the "Control-[" or the auditing toolbar:

#N/A #VALUE! #REF! #DIV/0! #NUM! #NAME?

Until these are corrected the model will continue to have errors.

2. Find any inconsistencies in the sheets

Use the F5-Special-Row differences on each sheet to highlight where different formulae have been used across a row.

Find what is the appropriate formula to apply all the way across the row and then copy this across for consistency.

3. Balance sheet not balancing

Find the difference in the balance sheet in the first period of imbalance:

If the difference is recognisable – error of omission – the entry has not been entered in all the appropriate places.

If the difference ÷ 2 is recognisable – the entry has been made but added rather than taken away or vice versa.

4. Check specific diagnostics

A good model should have specific diagnostics telling the user when errors / inconsistencies have occurred, such as the need to press F9 to recalculate the data tables. Ensure that all these diagnostics have appropriate messages.

5. Sense checks

By eye and calculator, check as to whether the output numbers are sensible.

Modifying models

In a perfect world, every new project should start with a new model rather than taking one used on a previous assignment. However, time constraints often mean that old models get re-worked. The following are things to do / look out for when modifying such models.

1. Unhide / de-group

Rows and or columns may be hidden and / or grouped and so not all the model is visible. On each sheet:

- Find the size of the active area of the sheet (Control + End will go to the junction of the last row and last column)
- Select all rows above this point (Shift + Spacebar followed by Control + Shift + Up arrow)
- Right mouse in the area and select Unhide
- Then follow this procedure for columns.

Once all hidden data has been unearthed, the grouped data can be unveiled:

- Select the entire sheet (Control + A) then Press Data; Group and Show Detail.

Additionally, all hidden sheets should be viewed by:

- Pressing Format; Sheet; Unhide and select all hidden sheets.

2. Remove previous data

- On each sheet select all hard inputs (press F5, then Special then select only Constants and Numbers)
- Delete all these numbers.

Unfortunately, this will not delete all inputs:

- Those where two or more numbers have been put together in a cell (as this is regarded as a formula and so not caught by the above procedure)
- Where inputs are not numbers, eg currency, project names etc. Look out for these throughout the model as they are likely to be in may places.

Additionally, this procedure may also delete some inputs which should not be removed, e.g. column or row counters (which are then used in subsequent formulae to locate data) and the results of switches (which frequently deliver a number as their output).

3. Look for inconsistencies

When time is short towards the end of an assignment, models are amended quickly without thought that they need ever be changed back. As a result, some quick fixes may appear in the model version being used. One way of identifying these is using F5 again:

- Select as much data as possible on each sheet
- Press F5, then Special, then select Row Differences
- All cells where formulae are inconsistent across that row will be selected. It may be an idea to highlight (paint the background colour) of all of these cells whilst they are selected. The inconsistencies can then be investigated in turn.

4. Do not delete

In short, do not delete anything. However, it may be that there is too much analysis for your purposes. If this is the case:

- Hide excess sheets (Format; Sheet; Hide)
- Group excess rows and columns (Data; Group; Group and Outline) – this is a cleared way of doing it than using Hide.

If, however, data is to be deleted:

- Select each item to be deleted and use the Auditing tools (Tools; Formula Auditing; Trace Dependents) to find those cells which are dependent on it. If the message "The Trace Dependents command found no formulas that refer to the active cell" then it would appear that this cell can be deleted
- Caution: if the cell is being referred to as part of an OFFSET or INDIRECT function or within Visual Basic then this test will not find the dependent
- After deleting each set of data, have a look at the key outputs and determine whether the error message #VALUE! or #REF!. If this is the case, then the deleted data must be dependent on the deleted data.

Appendix

Excel tricks

Auditing consistency over columns (highlights rows that are inconsistent)

- Select the appropriate columns; F5; Special; Row differences (or Constants if inputs / hard-wired numbers are to be identified)
- F5, Special can also be used to find conditional formatting, data validation, row differences …

Auditing toolbar

- Ensure this forms part of your toolbar to enable inconsistencies to be spotted quickly
- Double clicking on the trace precedents / dependents tool will show both direct and the next indirect precedent / dependent
- Double clicking on the arrow takes the cursor to the end of the arrow
- Where an arrow points to another sheet, double click on the dotted arrow which gives the relevant locations in the Go To dialogue box

Column selection

- Control+space bar; or
- Place cursor on column header – Left mouse button
- Control+- to then delete selected column; or
- Control++ to then insert a column

Comment insertion (descriptive labels for more complex calculations)

- Shift+F2; or right mouse button
- Shift+F10; Insert comment

Conditional formatting

- Cells; Conditional Formatting; (Alt-O; D) and then follow the prompts
- F5, Special can also be used to find conditional formatting on selected sheet

Constants creation (dollarising)

- F4 - pressing F4 toggles between the various dollar options

Data validation (to ensure only valid results can be input)

- Data; Validation; and then follow the prompts

Find

- Shift+F5 or Ctrl+F

Format painter

- Put the paint-brush symbol on the toolbar to allow for easy copying of formats. Double clicking on the paint-brush symbol retains the copied format, so that it can be applied to further cells straight after. Press Esc key when finished with copying formats
- Alternatively: Ctrl+C on the cell(s) with the appropriate format; go to target cell(s) and Alt+E; S; T (paste special, formats)

Formatting numbers for consistency

- Control+1
- For use of _ #; , see Formatting section

Function wizard

- fx button — to use function wizard or Shift+F3
- type in name of function preceded by =; press Ctrl+A to go directly into the function wizard for that function

Go To

- F5
- Control+Home — Top of sheet
- Control+End — End of active part of sheet, i.e. the junction of last row and column used
- Control + any arrow — Goes to the start / end of the block of formulae / data that the cursor is in
- Control+Page Up / Page-Down — Previous / next sheet
- Control+F6 or Control+Tab — Switch between open workbooks
- Shift+F6 — Switch to other window when screen is split

- Control+[— Moves the cursor to the precedent cells (on same sheet); Moves to the first precedent cell in formulae if on different sheets
- Control+] — Moves the cursor to the dependent cells (on same sheet)

Graphs

- F11 produces instant best fit graphs for selected data
- Try dragging the lines to see what then happens

Hide extraneous columns to fit sheet to appropriate width

- Select the first column to be hidden (either by mouse or Control+Spacebar)
- Control+Shift-→ (selects the remaining columns on the sheet)
- Format; Column; Hide (hides all the highlighted columns)
- Alternatively, select columns to be hidden, Right mouse; Hide, or
- Select columns to be hidden, Shift+F10; Hide.

Insert

- Shift+F11 — New sheet
- Alt+I; R or C — New row or column
- Control++ — New row or column when column or row selected
- F3 — name into a formula

Listing names

- Insert; Name; Paste; Paste List
- Alternatively, F3, Paste List

Menu selection

- Alt followed by underlined letter to get to first level (e.g. Alt+F to enter File menu);
- To get to next level merely press the letter (e.g. U to enter Page Setup)

Naming a cell / range

- Type in text in cell to the right of cell or range
- Control+Shift+¬; then F3 (whilst Control+Shift still held); check the right box; Return

Protecting the contents

- Tools; Protection, Protect sheets – leave the default boxes ticked and do not bother with a password. This stops any editing of the sheet.
- Selective protection – see Protecting the model

Repeat previous action

- Control+Y, or F4

Replace

- Control+H

Reveal / hide formulas

- Control+` (i.e. the top left key on the standard UK keyboard). This toggles between showing the results of formulae in the cells and the formulae themselves

Right click mouse button menu

- Shift+F10 (often there is a right click mouse button on the bottom row of keyboard)

Row selection

- Shift+space bar
- Place cursor on row header – left mouse button
- Control+- to then delete selected row; or
- Control++ to then insert a row

Save model (often)

- Control+S

Save model as …

- F12 – useful to do at the start of each major change as a new version

Select

- Control+Shift + any arrow — Selects cells to start / end of next / current series
- Shift + any arrow — increase the selection one cell at a time in that direction
- Control+A; or — All of current sheet
- Control+shift; space bar; — All of current sheet
- Control+space bar; — Column
- Shift+space bar — Row
- Control+Page Down / Up — Select next sheet / previous sheet
- Control+Shift+Page Down / Up — Select sheets (file name now includes [group])
- Alternatively, Right mouse on a sheet tab – Select All Sheets

Sensitivity table creation

- Ensure it is on the same sheet as the inputs to be varied
- Data; Table (see notes)

Switch creation

For example

- Open the Forms toolbar (View; Toolbars; Forms)
- Select the check-box and create its text
- Using the right mouse, Format Control; Control; Cell Link (giving cell reference for an unused cell which will now switch between reading either TRUE or FALSE)

Switching between sheets

- Control+Page Up / Down

Switching between split sheets

- Shift+F6

Switch to other open workbooks / documents

- Control+F6

9 • Financial modelling – transition to Excel 2007

Introduction and objectives

Initially, migrating from Excel 2003 or XP (03) to Excel 2007 (07) is likely to be daunting because the look and form of 07 is rather different. However, the migration to 07 should, with the assistance of this chapter, be a relatively smooth process. Over time it will become apparent that the new features included in the 07 product are an improvement on what was already a very good financial modelling product.

Thankfully, many of the shortcuts within the 03 product continue to apply to the 07 product.

This chapter will focus on the changes brought about by the introduction of the 07 product from a financial modelling perspective.

Audience

This chapter aims to introduce existing financial modellers to the new features and so should be read in conjunction with CTG's best practice financial modelling notes. It assumes that the reader is familiar with the features of 03 and will act as an aide to migrate from the 03 product to the 07 product.

Microsoft migration tools

Microsoft has provided an excellent migration tool available on the web. This tool does not include any narrative or coaching, it merely shows the location of functionality between the 03 and 07 products. The web link is highlighted below. Alternatively, the web link has been included on the CTG website (www.ctguk.com), within the resources page.

http://www.microsoft.com/downloads/details.aspx?FamilyId=89718ABD-2758-47B3-9F90-93788112B985&displaylang=en

New layout

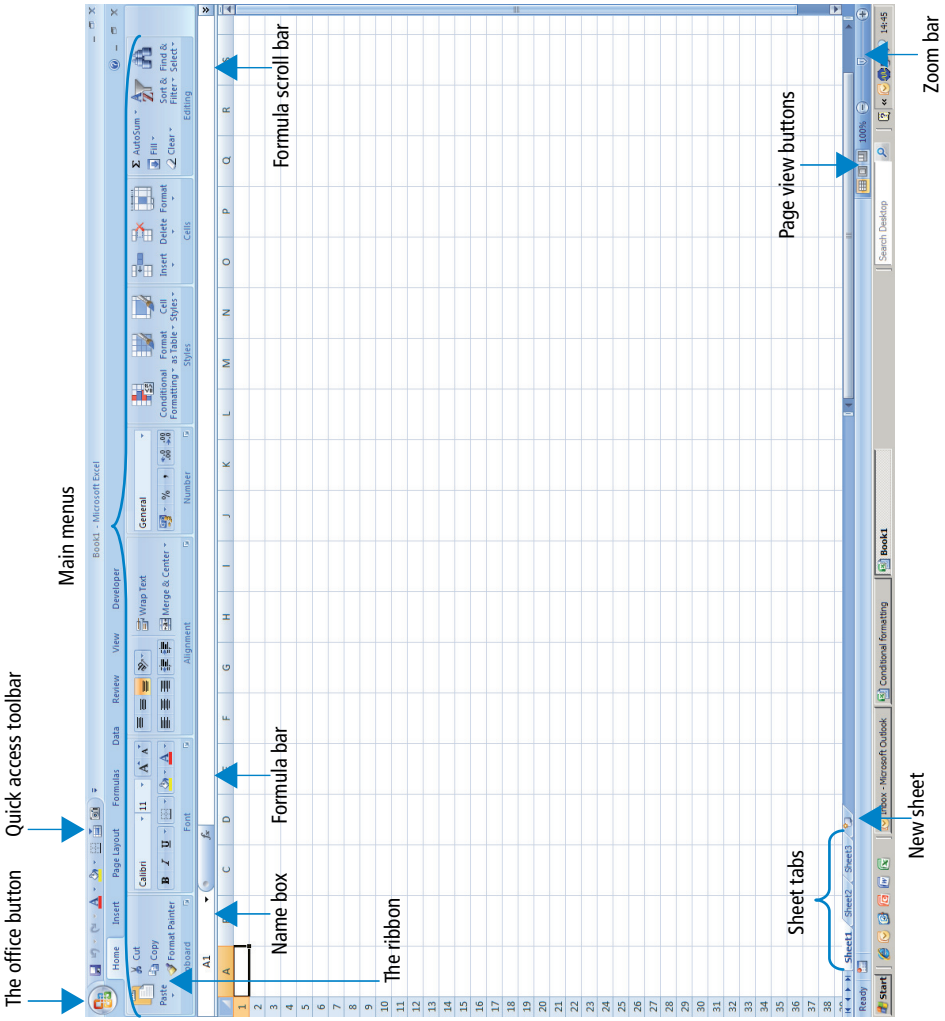
Open 07 and the changes within the new product are immediately apparent. The worksheet menu area has changed significantly. The menu headings, the number of buttons and the order of the information have all changed. It will take time to get used to these changes. For instance, switching all calculations to "automatic except for tables" was a straight forward exercise through the Tools menu and the options sub-menu. However, in the 07 product there is no Tools menu to use. The excel options menu is now included in a new area of the product called the office button. It is this initial type of frustration that this chapter is aiming to overcome. As with any product migration, the frustration is short term, as the new eventually becomes the norm.

The 07 product has been put together for the masses, as it is clearly a mouse driven product. Those of us using Excel on a professional day to day basis, where speed, accuracy and efficiency are top priorities, are probably more reliant on the use of keyboard shortcuts, rather than using the mouse to find the relevant button to click. Thankfully, as the appendix to this manual sets out, most of the shortcuts you have become accustomed to still operate within the 07 environment.

The key layout issues are:

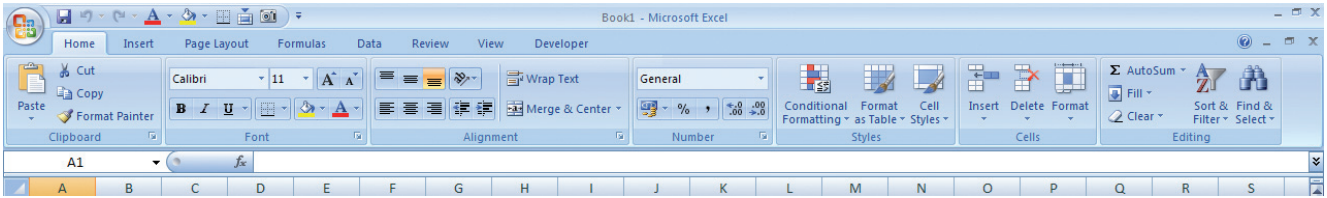
- New menu layout
- The ribbon
- Larger worksheet area
- Page setup
- View functionality
- The office button
- Excel options
- The quick access toolbar.

Each of these layout issues is considered on the following pages, starting with a screen shot highlighting the various buttons and other features of the 07 product.

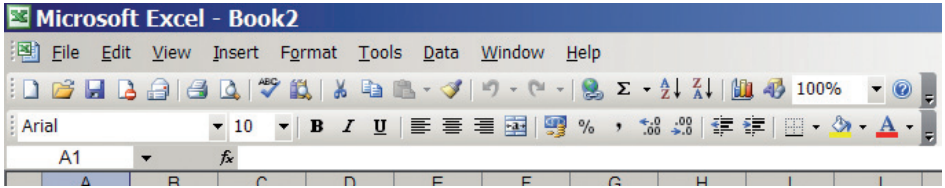

The office button
Quick access toolbar
Main menus
The ribbon
Name box
Formula bar
Formula scroll bar
Sheet tabs
New sheet
Page view buttons
Zoom bar

The ribbon

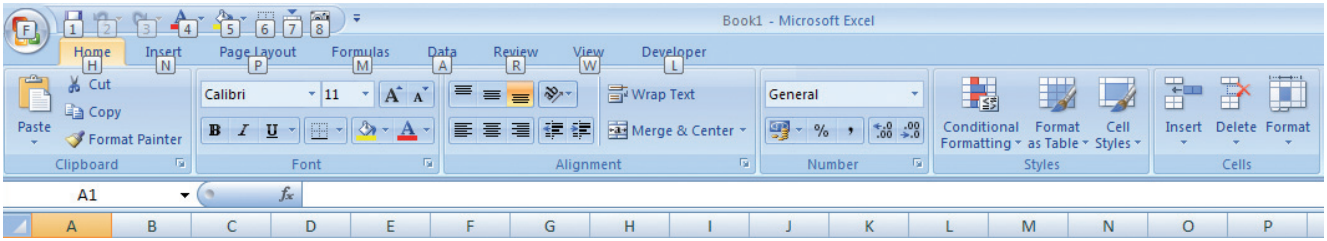
Below is a more detailed screen shot of the typical 07 product workbook layout. The layout is much more mouse orientated than the 03 product, with all major functions now accessed with the use of the left mouse click. The menus can still be accessed via the keyboard by using the **Alt** button followed by the relevant letter(s) that has been allocated to each button within the 07 product.
This new layout is called the "ribbon."



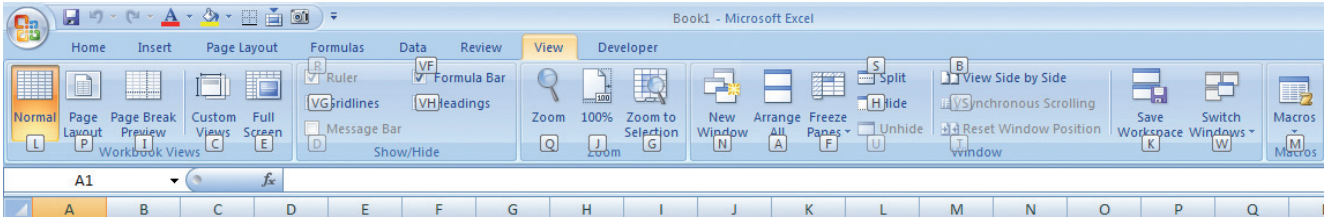
Compared to the 03 product the layout is quite different, with the different menus and button and sub-menu organisation.



Pressing Alt once reveals the keyboard letters required to access the main menus.



Pressing W on the keyboard changes the ribbon to reveal the 'view' buttons.



So, for example, whereas the keyboard shortcut under 03 to freeze panes was Alt-W-F, under 07 it remains as Alt-W-F, but then you will be offered three options – freeze panes, freeze top row, freeze first column.

The ribbon is probably the most dramatic change in the 07 product. It is the main user interface in the product. The traditional menus and toolbars, as we have mentioned, have gone and they have been replaced by the ribbon.

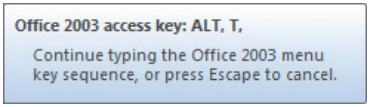
The commands available in the ribbon vary depending on which tab has been selected. As a quick overview the main elements of the ribbon are:

Ribbon tab	Overview	Short cut to access
Home	This contains the basic formatting tools, cut, copy and paste as well conditional formatting	Alt-H
Insert	Used for inserting graphs, pivot tables, illustrations and text	Alt-N
Page layout	Includes the functionality for altering the look of the workbook and printing requirements	Alt-P
Formulas	Includes the excel formula tools and the naming functionality and management	Alt-M
Data	Data related commands	Alt-A
Review	Includes all the proofing, track changes and comment management	Alt-R
View	Management of windows, view options and zooming	Alt-V
Developer	Macro functionality and the switch (VBA) tools used for scenario management building	Alt-L (see below)

Developer

The developer menu does not appear as standard but can be added easily. Left click on the Office button (Alt-F), select excel Options (Alt-I) and then select **Show Developer tab** in the ribbon (Alt-D).

For those of us more familiar with the 03 product, knowing the short cuts required to navigate around the menus and sub menus, 07 does offer an olive branch. If an 07 user attempts to navigate the workbook menus using the 03 menu shortcuts, for instance attempting to access the old 03 Tools menu using the Alt-T shortcut, the 07 product will pop-up the assistant menu below.



This menu allows the user to navigate the 07 product with the 03 menu shortcuts. Obviously this is only of use if the user is familiar with the 03 product navigation shortcuts. If the user continues to navigate from the above assistant menu position and for instance, types in the letter "O", as would be required to access the options menu under the 03 product conditions, the 07 product will take the user to the excel options menu. Excel 07 copes reasonably well with the stubbornness of the 03 user who wishes to stick to the 03 menu navigation.

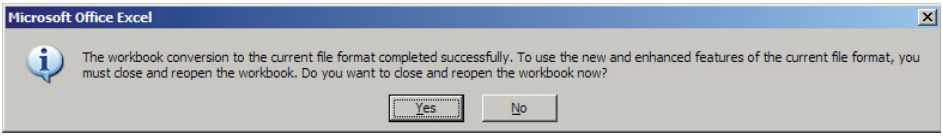
Larger worksheet area

For users who struggled to build financial models within the 03 worksheet area, where 16 million cells per worksheet tab were just not enough, the 07 product has come to the rescue. The worksheet area per tab has increased significantly. Each tab now has 1,048,576 rows and 16,384 columns. This surely must be more than enough spaces for all but the most foolhardy.

Note that if you are working in compatibility mode so that it is compatible with 03 workbooks, you will not have the extra rows and columns (and a host of other new features).

If you are happy not to work in compatibility mode, it is possible to convert the workbook to 07. To do this, left click on the Office button and select convert (Alt-F-V). If the file is closed and then reopened, it will then have the new features. It may be a good idea to save the previous version first (perhaps including 03 in the name).

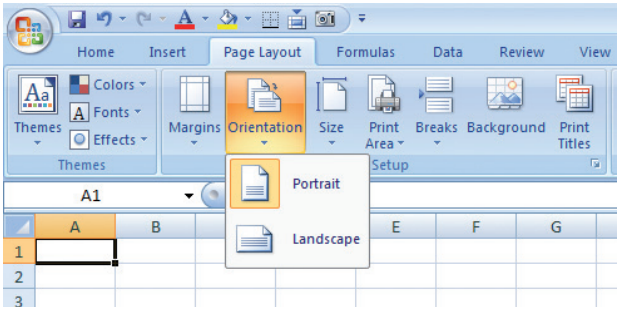
The following dialogue box will appear:



Once this conversion has taken place, it is not then possible to open the file using Excel 2003 version.

Page setup

The page setup functionality in the 07 product is very similar to the 03 version, however, the location of the menus is different. The Page Layout menu contains all of the page setup requirements. As with the 03 product if all sheets are grouped (still with the Control Shift Page down shortcut), the page setup can be completed for all sheets at the same time.

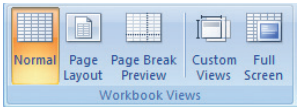


View functionality

The 07 product has an entire menu dedicated to organising the way Excel worksheets can be viewed. Alt-W or a mouse click will give the user access to the view menu.

This menu will allow the user to change the workbook views between:

- Normal
- Page layout
- Page break preview
- Custom view
- Full screen.



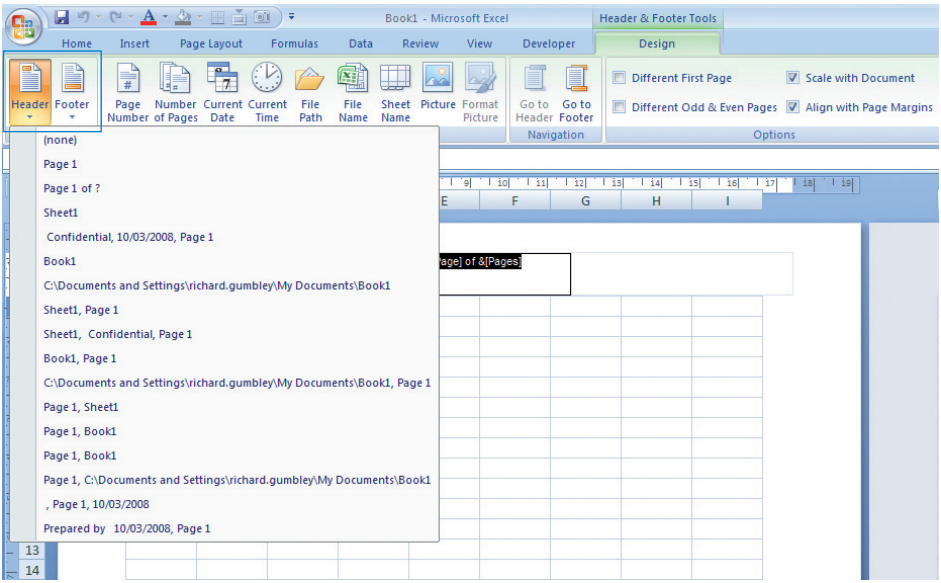
The normal view is the standard workbook view.

The page layout view (Alt-W-P) is a new addition to the 07 product. This view is really an editable print preview option. Within the 07 product this view will usually be used to create and format headers and footers.

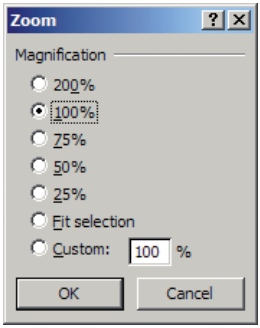
The extract below illustrates the appearance of the page layout view. The views will illustrate what the spreadsheet will look like when printed out given the current page set up parameters for the workbook.

When the user clicks into the footer or the header (you have the choice of clicking in the centre section or the right or left of both header and footer), a new design menu will become active in the toolbar. This design menu allows the user to define the content of the headers and footers.

Please note that the 03 menu for setting up headers and footers can still be accessed, through the Page Layout menu, by selecting Print Titles (Alt-P-I).

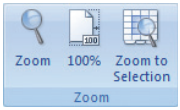


If a user wishes to zoom in on a part of the workbook there are a few options. The 03 short cut of Alt-V-Z will open up the traditional zoom menu below.



Alternatively, 07 has a very detailed View menu, which allows the user to:

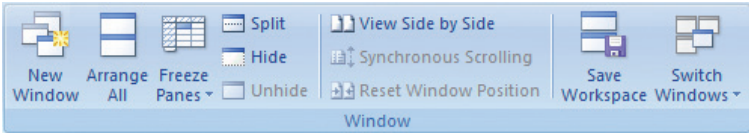
- Zoom through the traditional zoom menu either with the mouse or via Alt-W-Q
- Zoom to selection (Alt-W-G), where the user can highlight and define an area to zoom in on.



- Zoom via a scroll bar located in the bottom right hand corner of the workbook area.

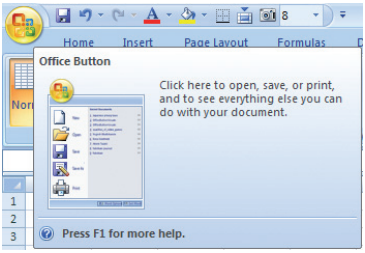
A very useful tool within 03 was the ability to view more than one window in an active workbook. This entailed opening a new window through the windows menu and then arranging windows so they were both viewable on an active screen. Users were then able to make changes in one window, whilst viewing the impact in another.

The same functionality exists in 07, but it is now through the View menu (Alt-W-N opens a new window, Alt-W-A allows the windows to be arranged).

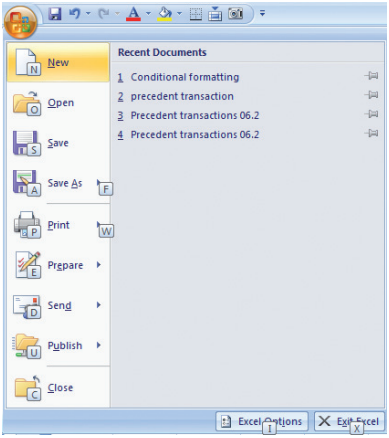


The office button

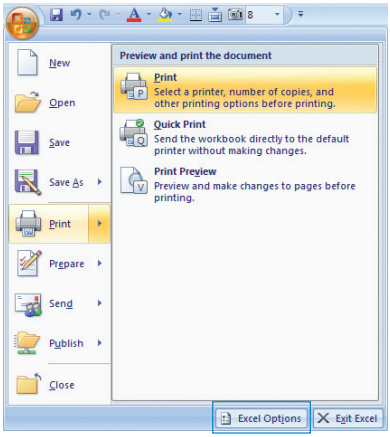
The office button in the 07 product is really a rearrangement of the File menu from 03. This menu is accessed using Alt-F or by clicking on the office button .



These menus give the user access to the file management, saving, printing and Excel options functionality that would have previously been included in the file menu in the 03 product.



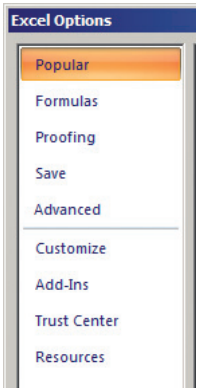
Do note how Excel not only underlines letters to denote the fact that the keyboard can be used to access menus, but also letters appear on buttons everywhere. The following menu was accessed using Alt-F-W.



Excel options

The 07 product has changed the location of the Excel options menu. The options menu is included as part of the office button menu. Previously the Excel options menu was included in the Tools menu under Options.

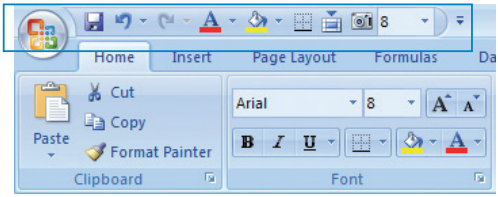
The organisation of the excel options menu is a little different to the 03 product:



Sub-menu	Sub menu used to:
Popular	Alter default fonts, sizes, number of sheet tabs, set up live preview and mini toolbars
Formulas	Set calculations, switch on iterations, background error checking
Proofing	Set the spelling check parameters
Save	Set the auto save parameters and the back up save locations
Advanced	Set detailed excel options – for instance, after pressing enter setting excel to move the cursor downwards
Customise	Customising the quick access toolbar (see below)
Add-ins	Adds in additional functionality. For instance, the analysis tool pack add-in will add statistical data analysis tools into the excel workbook. For example, this would be required for users wishing to regress their own betas using the excel regression tool
Trust centre	Privacy protection and security
Resources	On line resources links into Microsoft.com

Quick Access Toolbar

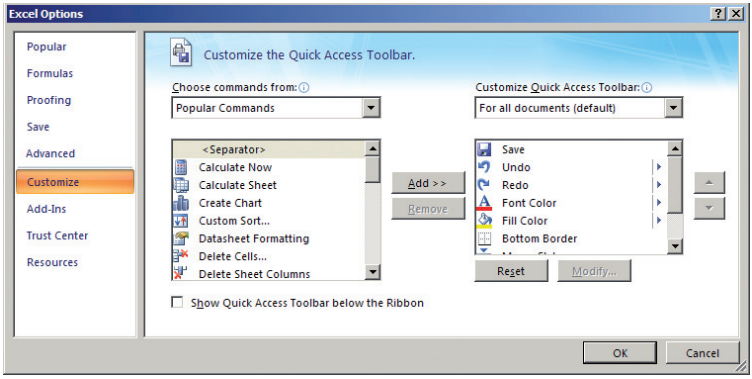
A very useful addition to the Excel 2007 version is the quick access toolbar – highlighted below. This toolbar can be set up to include key toolbar buttons that may be useful and that can be accessed quickly with the keyboard.



Typical buttons that are useful and repeatedly used by financial modellers would be:

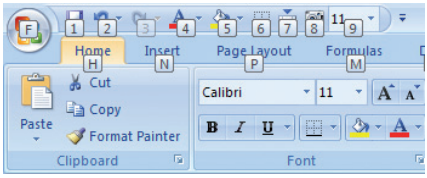
- Font colours and fill
- Borders
- New cell style
- Camera.

In order to customise the quick access toolbar, the user must hit the office button (Alt-F or) and enter the excel options menu at the bottom of the menu. The customise menu is located on the left side navigation area. Here commands can be chosen and added to the quick access toolbar. Every Excel 2007 button is included in the 'choose commands from' menu.



The quick access toolbar can be customised for an individual worksheet or for all documents using the customise quick access toolbar menu in the top right hand corner of the menu.

Once the quick access toolbar has been customised, the buttons can be navigated easily by entering Alt and the appropriate number of the button on the toolbar:

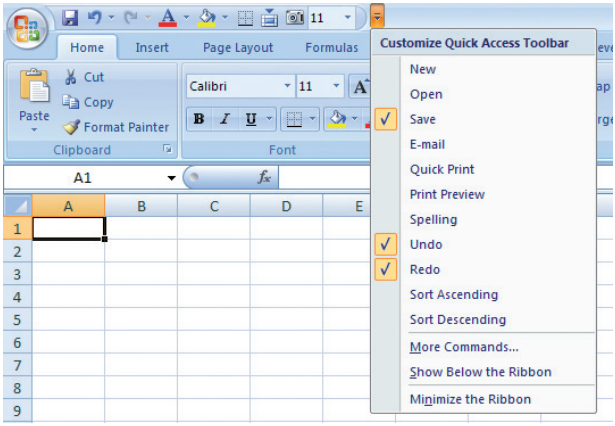


In the above example the quick access toolbar has been setup and each button can be accessed by pressing Alt and the corresponding number:

1. Save
2. Undo
3. Redo
4. Font colour
5. Fill colour
6. Borders
7. New Styles
8. Camera
9. Font size.

One click quick access commands

Another new piece of functionality embedded in the quick access toolbar is a drop down menu included at the end of the toolbar. Clicking on this drop down arrow opens up a menu of standard and frequently used commands. The menu also includes another way to customise the toolbar through the **More** commands option.

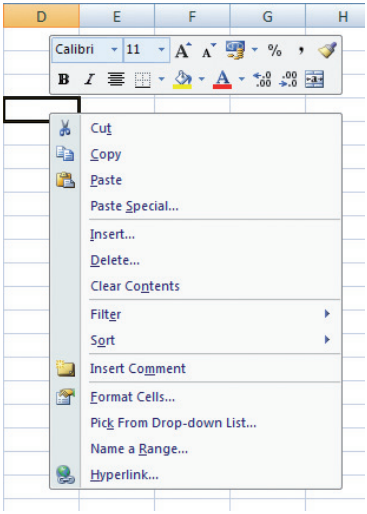


Formatting

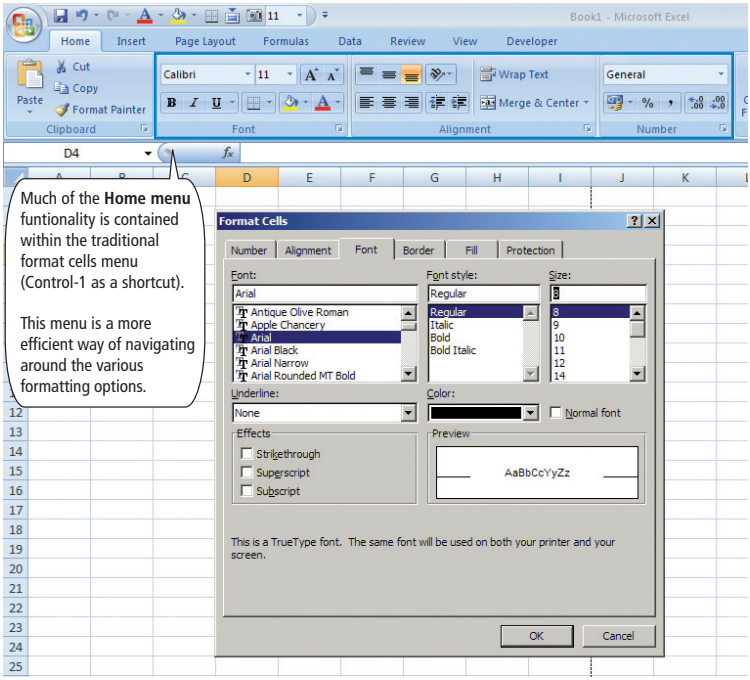
The bulk of the **Home menu** in the 07 product focuses on the formatting of information in the workbook. All of these buttons can be navigated with the mouse as well as the keyboard.

There are no significant changes to the basic number formatting conventions in the 07 product. So those who are used to the basic custom number formatting conventions in 03 will not have to deal with any new 07 functionality.

However, a new and potentially useful tool within the 07 product is the mini toolbar. The toolbar forms part of the right click menu. The mini toolbar allows the user to quickly apply basic format ideas to text and numbers. Unfortunately, the mini-toolbar cannot be customised.



The bulk of the **Home menu** can be more efficiently navigated using the format cells menu that is accessible via the Control-1 shortcut, as shown below.

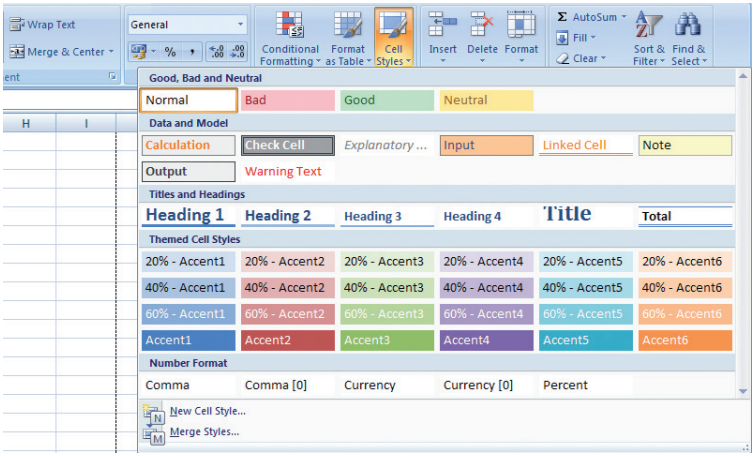


Styles

Styles are possibly one of the most underused areas of the Excel product. The 07 product has been revamped with a significant increase in the number of default styles included in the package that may be useful to the financial modeller.

The style functionality is now found in the **Home menu**. The extract below displays all of the new default styles that are now included in the 07 product (Alt-H-J).

A new feature is the introduction of the "live preview". This feature will display the impact of the styles directly into workbook – so that when the mouse glides over the style options, the selected cell or range in the workbook temporarily displays the style (unless the style options area completely covers the chosen cell(s)!). When you identify your chosen style, click on the selection and the preview will be chosen and applied.

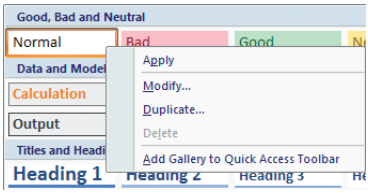


The 07 product still retains the style control available in the 03 product, where the user is able to:

- Modify an existing style
- Refine the normal style
- Create new styles
- Merge styles from an another workbook into the active workbook.

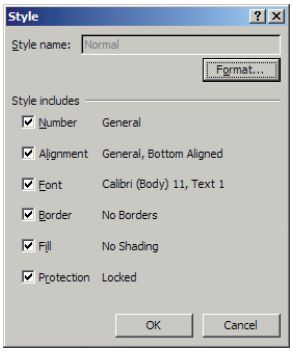
Modifying an existing style

To modify an existing style the user must go through the Home menu and hit the style button (Alt-H-J). This will open up all the styles available in that particular workbook. The user simply picks the style that is to be modified and right clicks it (or Shift F10). This opens up the style dialogue box below.



In building a financial model, it is typical to redefine the basic "normal" that is defaulted in Excel. Therefore a right click / Shift F10 and modify on the normal style will allow the user to redefine the normal style to a financial

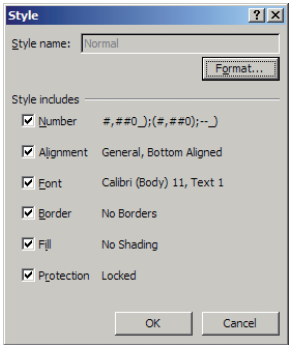
modelling standard (see best practice financial modelling notes for number formatting detail).



The modify option brings up a new type of style modification menu in the 07 product. It is from here that the style is directly modified. The dialogue box above is displaying the standard normal Excel format (General number formatting and alignment etc.).

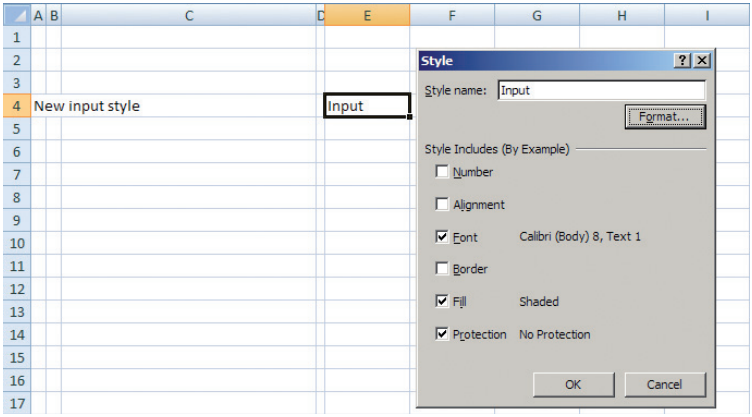
Alt-O will allow the user to modify the format of the style. The format button opens up the standard format cells dialogue box. Using these menus the style can be formatted as the user desires.

The dialogue box below illustrates the amended normal style introducing a more precise financial modelling number format, font style and font size. Hitting the **OK** button will amend this normal style throughout the workbook.



Creating a new style

As with the 03 product, 07 allows users to define their own styles. The example below illustrates how new styles are created within 07, using an input styles as an example style. Cell E4 below has been formatted with a yellow background colour, blue font and not protected.



To record this formatting as a style, the user must go back into the Home menu and into the cell styles button and take the new styles option found at the bottom of the style listings (Alt-H-J-N). This opens up a new style dialogue box. The user must then:

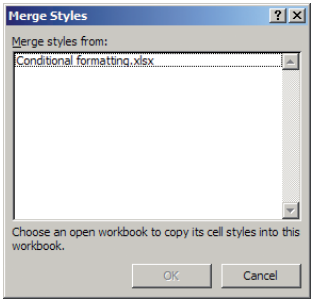
- Enter a new style name in the style name box. The check boxes display the current formats for the cell. By default all check boxes are checked
- If you do not want the style to include one or more of the format categories, then remove the checks from the appropriate boxes. For instance, an input style needs flexibility on the number format, as inputs can be various types of number formatting as well as text. Therefore in the example above, checks have remained only in font, fill and protection. This suggests that this user wishes the input style to purely concentrate on getting the font and fill colour consistent, and for inputs to be unprotected even if a sheet is protected
- Click OK to create the style and to close the dialogue box.

Merging styles from another workbook

User defined styles are stored only in the workbook in which they were created. If a user has created some styles which would be useful in another financial model, these styles can be transferred over to the new model.

To merge styles from another workbook:

- Open both the workbook that contains the styles that you want to merge and the workbook into which you want to merge styles
- From the workbook into which you want to merge styles, choose Home – Cell Styles (Alt-H-J-M)
- Excel will then display the merge styles dialogue box. This box will display a list of all open workbooks.



- Select the workbook that contains the styles you want to merge and click OK. Excel will transfer across all styles to the new workbook.

Conditional formatting

The conditional formatting functionality within the 07 product has been significantly improved and the feature is now much easier to use. The key improvements in the 07 product are:

- There is no longer a limit to just three conditional formatting rules per cell. Users are able to define as many conditional formatting rules as necessary
- In past versions of Excel if more than one of the conditional formatting rules evaluated to true, only the first conditional format was applied. In the 07 product, all the format rules are applied
- The 07 product allows number formatting to result from conditional formatting

- 07 now allows a conditional formatting rule to reference cells in a different worksheet (without the need to name cells)
- In previous Excel versions, it was relatively easy to accidentally wipe out conditional formatting by copying and pasting a range of cells to cells that contained conditional formatting. This problem has been eliminated in 07.

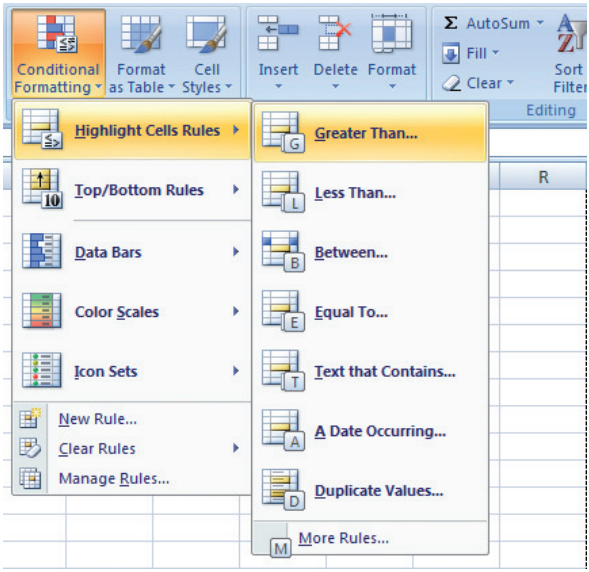
The conditional formatting menu is very different to earlier versions of Excel.

To apply a conditional formatting rule to a cell or range, the range must be selected and then one of the commands from the conditional formatting menu must be chosen.

The choices are:

Conditional formatting menu choices	
Highlight cell rules	This choice accords with the traditional use of conditional formatting. This option includes rules that highlight cells that are greater than a particular value, between two values, contain a specific text string or are duplicated
Top bottom rules	This type of conditional formatting will highlight, for instance, the top ten items, items in the bottom 20% or items that are above average
Data bars	Applies graphic bars directly to cells, proportional to the cell's value
Colour scales	Applies background colours, proportional to the cell's value
Icon sets	Displays icons directly in the cells. The icons depend on the cell's value
New rules	Enables the user to specify other conditional formatting rules for the selected cells
Clear rules	Deletes all the conditional formatting from the selected cells
Manage rules	Displays the rules manager dialogue box, in which the user can create new rules, edit rules and delete rules

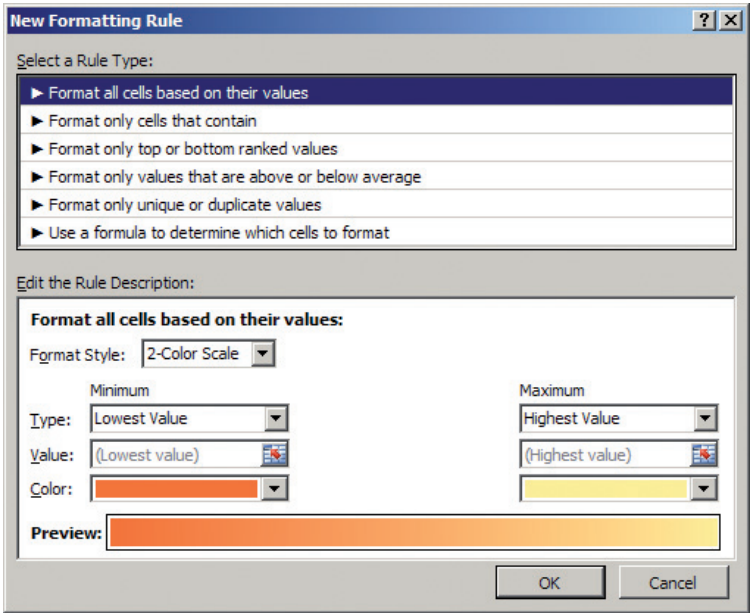
Alt-H-L open the conditional formatting menu.



User defined conditional formatting rules

The 07 product allows users to define their own conditional formatting rules through the new rules option of the conditional formatting menu. The conditional formatting new rules menu allows the user to recreate all of the default conditional formatting rules as well as new rules. As with all other conditional formatting, the user must select the numbers to be formatted and then hit the new rules options in the conditional formatting menu.

- The user then selects a rule type (see extract below)
- The rules description can then be edited using the dialogue information in the lower section of the box
- The preview pane provides an idea of the nature of the formatting to be applied.



Conditional formats using graphics

The spreadsheet extract below illustrates a few examples of how the new conditional formatting functionality in the 07 product can be very easily used. All of the examples below were set up by typing in the numbers, selecting the ranges and applying the relevant type of conditional formatting (Icon sets, data bars, colour scales etc.).

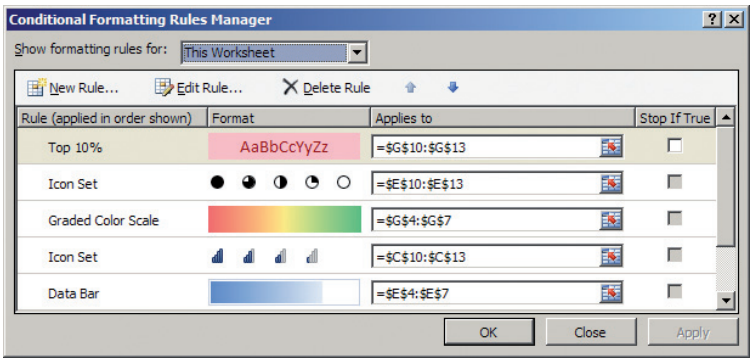
	A	B	C	D	E	F	G
1	Conditional formatting examples						
2							
3			**Icon sets**		**Data bars**		**Colour scales**
4			1		30		30
5			--		40		40
6			1		10		10
7			1		20		20
8							
9			**Icon sets**		**Icon sets**		**Top 10%**
10			30		30		30
11			40		40		40
12			10		10		10
13			20		20		20
14							

Conditional formatting rules manager

The conditional formatting rules manager (found at the bottom of the conditional formatting dialogue box in the Home menu) allows the user to fully manage the conditional formatting rules contained within the current worksheet.

Conditional formatting rules can be viewed for:

- A selection
- An entire workbook
- Individual sheet tabs.



Once the rules have been displayed, they can be edited or deleted. New rules can be added. The rule priority can also be altered within this manager.

Paste special

Paste special, under 03, is Alt-E-S followed by the appropriate letter, depending on whether a format (t), formula (f), value (v) etc. is to be pasted.

Under 07, the paste special menu is under the Home menu.

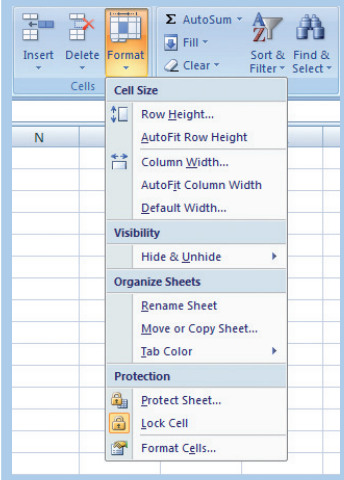
As before, Ctrl-C is applied to the cell which contains the particular quality to be copied. Then Alt-H-V – a menu appears of the various qualities that could be followed. One of the menus is the paste special menu from the 03 version.

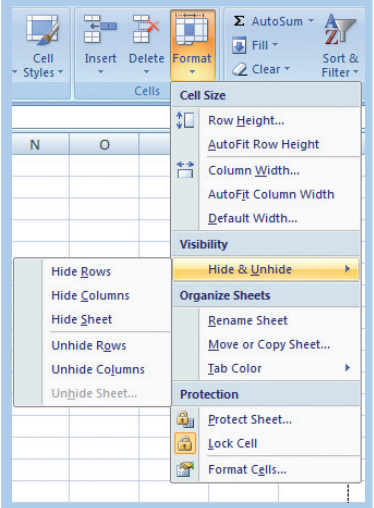
Workbook setup in 07

The best practice financial modelling notes take users through the process of setting up a workbook in preparation for building a financial model. Although the ideas are unchanged for a model setup in 07, the process is a little different compared to the 03 product.

The following section acts as a recap of a number of issues already discussed, within the context of setting up a financial modelling workbook from scratch.

Model setup per Excel 03 / XP	Model setup per Excel 07
Set calculations to automatic except for tables and switch off iterations. **Tools; Options; Calculation tab** 1. Ensure the Iteration box is not selected. If this is selected, Excel will iterate any circularities created within the model. Circularities make the model slower to calculate, unstable and more likely to crash. Often circularities within models are created in error or are unnecessary. Whilst the iteration option remains off, any circularities will be flagged (and can be eliminated) 2. Select Automatic except tables. The model will calculate automatically as the model is modified, but F9 must be pressed whenever Data Tables are to be calculated	**Set calculations to automatic except for tables and switch off iterations.** **Office button; Excel options; Formulas** Same as 03
Setting up the required number of sheets for the model Assess how many sheets are needed (and add one – it can always be removed). New sheets can be added by right clicking a sheet tab, choosing Insert and Worksheet or pressing Shift + F11	**Setting up the required number of sheets for the model** Same as 03. There is a Tab for inserting a worksheet, unfortunately this has to be clicked for every new sheet (the repeat function – F4 / Ctrl Y) does not work here

Model setup per Excel 03 / XP	Model setup per Excel 07
Group all sheets for editing Select all sheets to do consistent formatting (to set up group editing) Control + Shift + Page Down; or Right mouse on a sheet tab – Select all sheets	**Group all sheets for editing** Same as 03
Worksheet consistency and format Size the columns • Column A (small); Column B (small); Column C (big) • Natural indents for ease of reading text / headings • To allow sufficient "space" should it be needed • Column D (very small) Columns sizing through the **Format; Column; Width** menu • Put in all the years (and currency) – i.e. column headings • Column E is the 1st period and then copy the sequence across all relevant columns • Only if a period (e.g. y/e 31/8/07) is in the same column in every sheet throughout the model can the range name tool be used effectively • Leave a blank column at the end of the final period (make it small) • Allows easy insertion of further periods if they are subsequently needed • Allows the data to be selected more efficiently if there is a natural break • The final column after the blank will be used for recording range names	**Worksheet consistency and format** Same column sizing requirements as 03 Columns sizing through the **Home; Format cells grouping** 

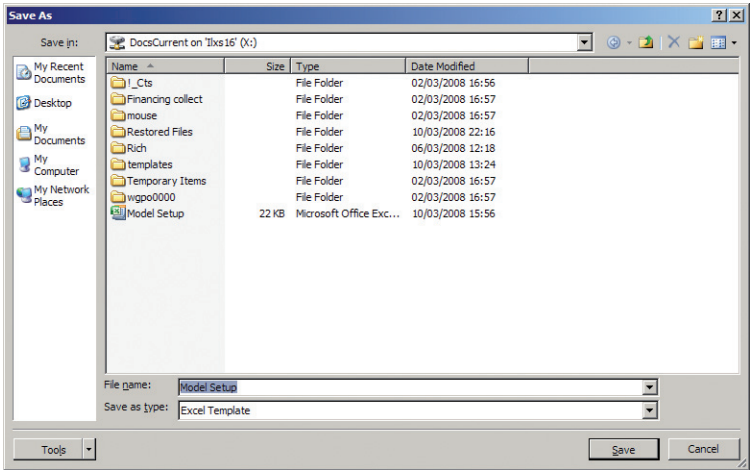
Model setup per Excel 03 / XP	Model setup per Excel 07
Fit the spreadsheet to the appropriate size: • Highlight the next column (after the range names column) • Control + Shift + → (selects the remaining columns on the sheet) • **Format; Column; Hide** or right mouse (Shift F10) followed by H, (hides all the highlighted columns)	**Fit the spreadsheet to the appropriate size:** • Highlight the next column (after the range names column) • Control + Shift + → (selects the remaining columns on the sheet) • Hide columns etc. through the **Home; Format cells (Alt-H-O), Visibility**  • Or right mouse (Shift F10) followed by H, (hides all the highlighted columns)

Model setup per Excel 03 / XP	Model setup per Excel 07
Print set-up If the sheets have been grouped together and you use the **File; Page; Setup** command, the settings you specify will apply to all sheets in the group • **Fit to page.** Landscape orientation is often chosen. If a standard layout has been adopted, all sheets will be a constant width but the length will differ. Page Setup offers a percentage value, or to fit to a specified number of pages. Rather than specifying one page wide by one page tall, the width requirement is entered and the height is left blank • **Default margins** are often too large and need to be adjusted • **Headers & footers** to include file name (and location if using Excel 2003); sheet name; date and time; and page of page (page & [Page] of & [Pages]). At times more information needs to be entered than the header / footer codes provide • **Print titles** (probably the periods) – will have to be done outside of the group edit as they are worksheet specific • **Remove the gridlines**	**Print set-up** The 07 product dedicates the **Page Layout** menu to setting up the look and layout of the workbook for printing purposes The **Page Layout** menu will be used to: • Fit to page • Default margins • Orientations • Sheet options • Print titles • Remove gridlines Headers and footers are best set up through the **View menu** through the **Workbook views** grouping. See notes on view functionality

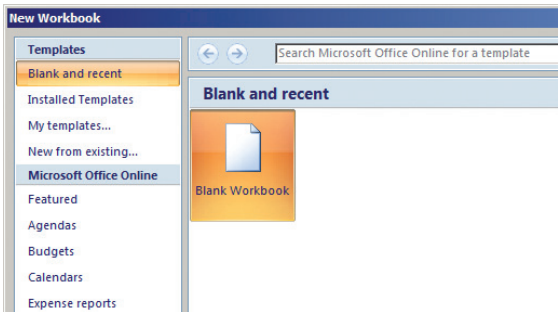
Creating a workbook setup template

Setting up a workbook from scratch ready for building financial models is a 10-15 minute task for an experienced modeller. The setup procedure is relatively standard from model to model. As a time saving device, once you have set up the model, the Excel document can be saved as a template. Therefore, each time a new model is required, a standard setup template can be applied, thus saving a little time during the initial set up procedures.

Once the setup has been completed, save the file as a template. The "Save As" (F12) command is include in the **Office** menu. This will display the traditional Save As menu. The user must then choose Excel Template from the **"Save as type"** field.



Once the template has been saved, it will be stored and the next time the user can apply the template to set up a new model. The template will be found through the **Office** menu within the **New** command. The 07 product has a number of embedded templates, which are listed in the new workbook dialogue box. All user defined templates will be stored in the "My Templates" option. Choose the setup template and the workbook will be setup automatically.

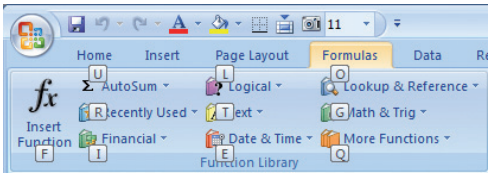


Formula assistance

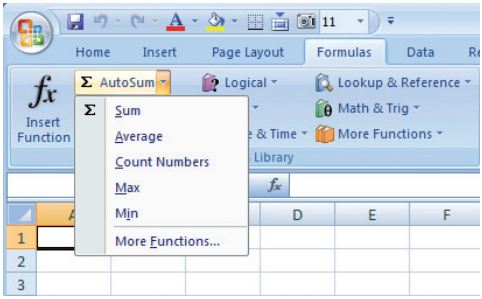
The 07 product now has its own dedicated formula main menu. All formula commands are contained within this area of the product. The function library within the **Formulas** menu conveniently organises the excel function list of some 340 standard Excel functions in to nine categories:

- Auto sum
- Recently used
- Financial
- Logical
- Text
- Date and time
- Lookup and reference
- Maths and trigonometry
- More functions.

The menu below is accessed using Alt-M.



The sum and other common mathematical formula commands can then be accessed through the sigma (Σ) drop down button. If a further function is required, more functions can be accessed.



Shift F3 also still works as a shortcut to access the insert function dialogue box.

New functions

The 07 product introduces five new functions:

New function	Purpose
IFERROR	Used to check for an error and display a message or perform a different calculation
AVERAGEIF	Used to calculate an average if condition fulfilled (similar really to sumif and countif)
AVERAGEIFS	Used to calculate an average if multiple criteria fulfilled
SUMIFS	Used to calculate a sum if multiple criteria fulfilled
COUNTIFS	Used to count if multiple criteria fulfilled

If these new functions are utilised in a financial model, bear in mind that the model cannot then be shared with users of earlier versions of Excel.

Resizable formula bar

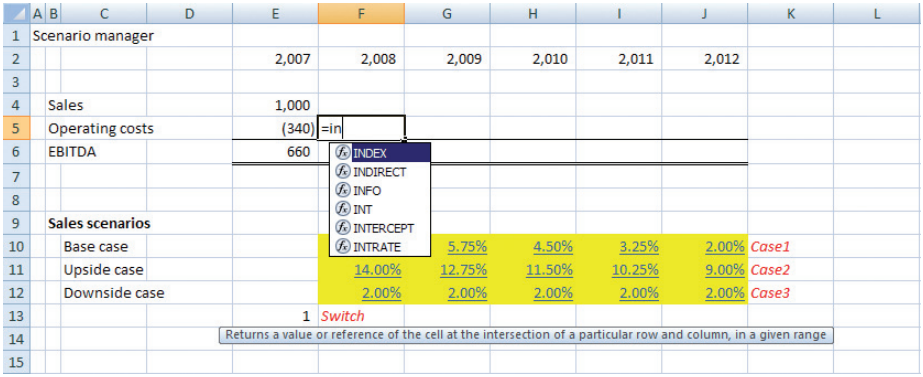
The formula bar automatically resizes to accommodate long, complex formulas, thereby preventing the formulas from covering other data in the worksheet. Users are able to write longer formulas with more levels of nesting (though not best practice!) than in earlier versions of Excel.

Function AutoComplete

Function AutoComplete is another useful addition to the 07 product. With Function AutoComplete, the user can quickly write the proper formula syntax. This enables the user to easily detect the appropriate functions and get help completing the formula arguments.

07 provides additional assistance in creating formulae by displaying a drop-down list that contains function names and range names. The items contained in the list are determined by what you have already typed. The extract below helps to illustrate this. The user in this extract has merely typed "=in" into cell F5 and excel has provided a drop down list with a selection of formulae that may be of assistance. The drop-down list has initially highlighted the index function and has provided a short description of what the function does.

Once the correct formula has been found from the drop down list using the arrow keys, press **Tab** and the formula will be added to the worksheet.



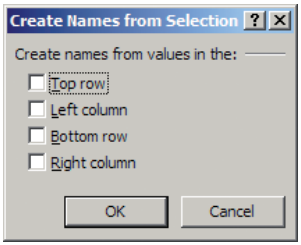
The formula assistance works with names and embedded formula as well. Getting to grips with this additional functionality will increase the speed and accuracy of formula construction in financial models.

Using Excel names

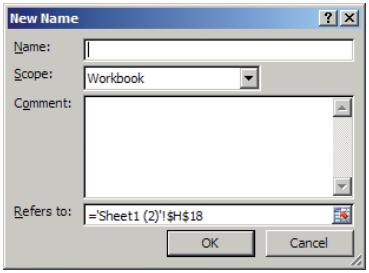
The actual process of naming cells and ranges within 07 is very similar to 03. Microsoft have added more functionality to this area of the product, making the use and management of names significantly easier. This has addressed an area of conflict amongst financial modellers, as some financial modellers have criticised the use of names due the difficulty of auditing a model containing a number of named cells and ranges. 07 addresses this issue with the introduction of the name manager.

Creating names

Names can be created in exactly the same way as 03 with the use of the Control Shift F3 shortcut. This will bring up the traditional create name dialogue box.



Alternatively, the name can be created using the new name dialogue box that has been included in the 07 product. Select the cell or range to be named and then choose the define name command in the **Formulas** menu (Alt-M-M-D). This will activate the new name dialogue box below.



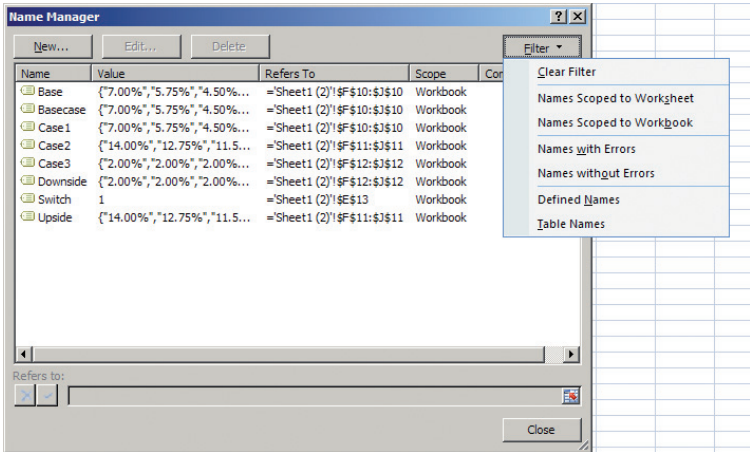
The name of the cell or range is typed into the "Name" field. The location of the named cell/range is displayed in the "Refers to" field.

A new feature of 07 is the ability to define the scope of the name. The scope can be set to apply to a whole workbook or just individual sheets. Users can also add a comment to be associated with the name. This comment can be very useful when using the name manager (next section) as it will assist in the auditing aspect of names within larger financial models.

The name manager

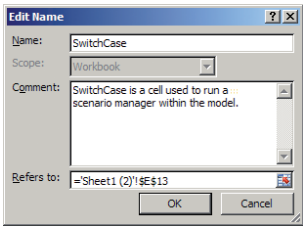
The name manager is an extension of 03's define name menu. The manager is accessed with the short cut Control F3. The name manager provides:

- Full disclosure of the cell reference
- Values included in the name cell / range
- Ability to filter the names according to purpose and
- Scope of the name (whether the name is workbook specific or not).



The new name manager dialogue box is re-sizeable to view more information as required.

New functionality included in the name manager is the ability to add comments associated with the name. If the modeller double clicks on a name included in the name manager list or hits the edit button (Alt-E) – the menu below pops up and allows the modellers to add comments to the name.



Such comments could outline the use of the name and how it is used within the model – especially useful for numerical switches.

Using names

The use of names within a financial model remains unchanged through the use of the F3 – paste names function.

Additional functionality has been included with respect to using names through the formula Auto Complete functionality.

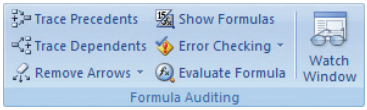
The extract below displays a choose function that will select from one of three named ranges. The formula has been partly set up and the user is about to define the three arguments of the equation. The user has just typed in the letter "c" and the auto complete function drop down list has kicked in to produce a list of names (at the top of the list) and functions that start with the letter "c". The arrow keys can then be used to find the relevant name or function and then the TAB key used to apply the appropriate name or function.

	A	B	C	D	E	F	G	H	I	J	K
1	Scenario manager										
2					2,007	2,008	2,009	2,010	2,011	2,012	
3											
4			Sales		1,000	=choose(E13, c					
5			Operating costs		(340)	CHOOSE(index_num, **value1**, [value2], [value3], ...)					
6			EBITDA		660						
7											
8											
9			**Sales scenarios**								
10			Base case			7.00%			3.25%	2.00%	*Case1*
11			Upside case			14.00%			10.25%	9.00%	*Case2*
12			Downside case			2.00%			2.00%	2.00%	*Case3*
13					1	*Switch*					
14											
15											

Case1
Case2
Case3
CEILING
CELL
CHAR
CHIDIST
CHIINV
CHITEST
CHOOSE
CLEAN
CODE

Auditing and associated issues

The 07 product has not changed the auditing functionality. The auditing commands are now grouped within the **Formulas** menu in the formula auditing grouping.



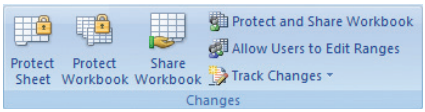
This functionality mirrors the content of earlier versions of Excel.

Other auditing tools that remain unchanged from previous versions of Excel are:

- F5
- F5 special
- Tracing precedents and dependents with Control-[or Control-]
- Revealing formula with Control-` (tilde)
- Background error checking (use the Excel options menu to manage).

Protection

Worksheet and workbook protection is unchanged in terms of the level of functionality in the 07 product. The protection commands are now included as part of the **Review** menu in the changes commands grouping.



Saving a workbook as a pdf file

A free Office 2007 add-in can be downloaded that enables the user to save a workbook as a PDF file. The add-in can be downloaded from:

http://office.microsoft.com/downloads

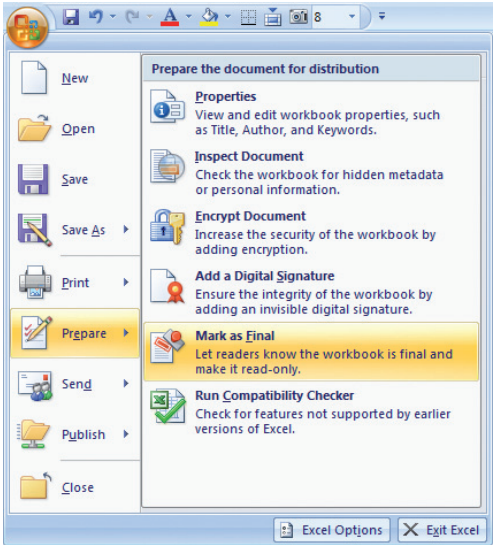
The PDF files format is widely used as a way of disclosing information to third parties in a read-only format that allows precise control over the form and content of the document. Once the add-in has been included, financial models can be saved in a pdf format via the "Save As" menu.

Finalising a workbook

Finalising a workbook is a new 07 feature. Models can be marked as final. This action will make two changes to the model:

- It will make the model read-only so that the file cannot be saved with the same filename
- It makes the workbook view-only so that nothing may be changed in the model. On opening a finalised document, the status bar displays an additional icon, and most of the ribbon is made inactive.

In order to finalise a workbook, go to the **Office** menu through **Prepare** and mark as final.



Marking a document as final is not a security measure. The finalising can be easily switched off by repeating the steps above through the **Office** menu.

Inspecting a workbook

In the same menu above, there is the option to inspect the document. This tool is useful if the user plans to distribute the financial model to others. Inspecting the workbook involves Excel checking the file for hidden data and personal information. The **toll** can locate hidden information about the preparer, the team or about the workbook that is not to be shared.

Comments

From a financial modelling perspective the use of the comment is an essential and often an underused tool. These comments form part of the documentation that supports a model. They should be used for:

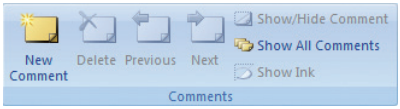
- Assumption justification
- Formula explanation
- Sourcing information
- General reminders.

Comments can still be inserted with the Shift F2 keyboard shortcut.

The 07 product however has added some additional comment management in the **Review** menu in the comments command grouping.

The comments grouping allows the user to:

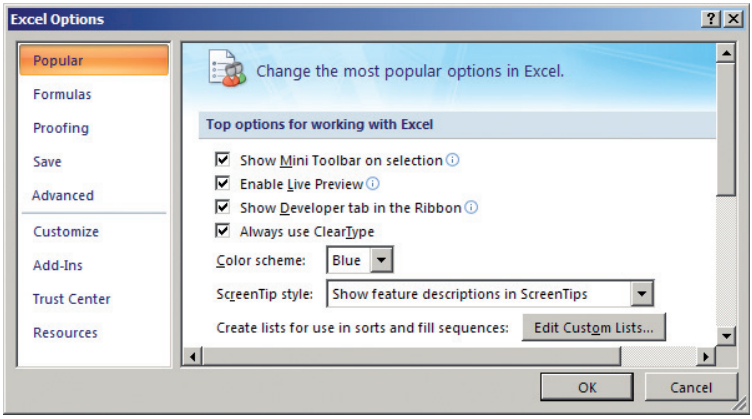
- Insert new comments
- Go to the next comment in the model
- Go to the previous comment in the model
- Show all comments
- Show / hide comments.



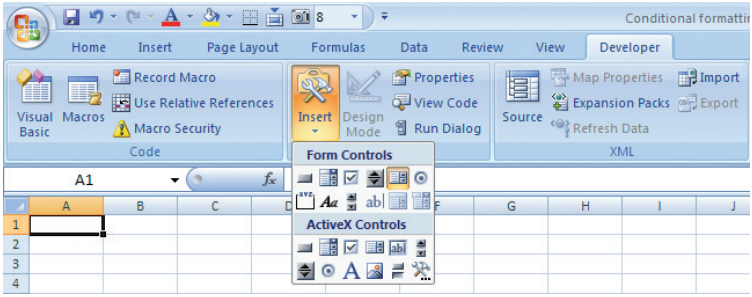
Using the VBA forms

In 03, switches used for running scenario managers etc. would be set up through the **View / Toolbars / Forms** menu like the example below.

Excel has moved this functionality into its **Developer** tab. On first using 07, this **Developer** tab may not be included in the workspace. The **Developer** tab must therefore be set up in the excel options menu with the **Office** button (as discussed earlier). The 'Show Developer tab in the Ribbon' checkbox is included in the popular excel options area. Tick this box and the **Developer** tab will be disclosed.



The **Developer** tab includes all the relevant VBA tools necessary to set up switches and scenarios within the financial models.



The setup of these switches is unchanged from previous versions of Excel.

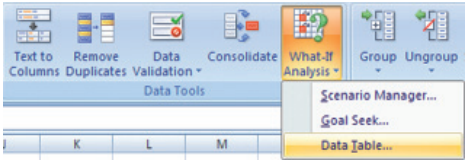
What if analysis (data tables etc.)

Data table functionality in the 07 product is unchanged. However, the location of the command is now located in the **Data menu** under the data tools grouping as part of the What-If analysis.

The What-If analysis groups together:

- Scenario manager
- Goal seek
- Data tables.

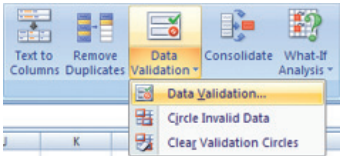
All three of these tools operate in the same way as the previous versions of Excel.



Data functionality

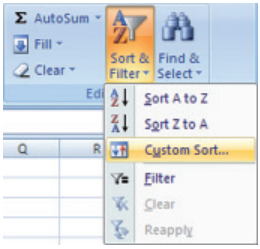
Data validation

Data validation operates in the same way as previous versions of Excel and is found within the data tools under the **Data menu**.



Sort and filter

The sort and filter functionality is now housed in the **Home menu** as part of the editing grouping.



Charts

The 07 product has introduced no new charts types. However, the appearance of the charts has been significantly improved (much nearer to pitch quality) and the process of formatting the charts is now much more user friendly.

The commands for charts are initially included in the **Insert** menu under the Charts command grouping.

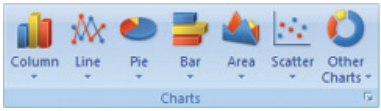
Once the chart has been created a new **Chart tool** menu set will be added to the ribbon. The **Chart tool** menu set includes three new menus in the ribbon:

- Design
- Layout and
- Format.

These three menus are dedicated purely to the graphical functionality contained within the 07 product.

Inserting charts

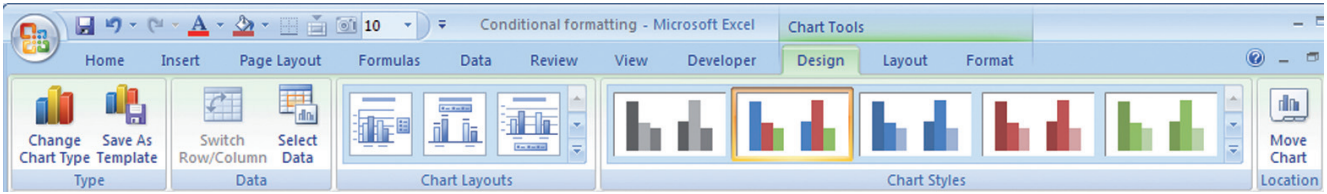
Charts are very easily inserted into a model. Simply selected the required chart data and insert the chart through the **Insert** chart menu. The user has the ability to choose the initial chart type. This chart type can be changed at any point following the initial choice.



Charts can still be created via the F11 shortcut once the appropriate data has been selected.

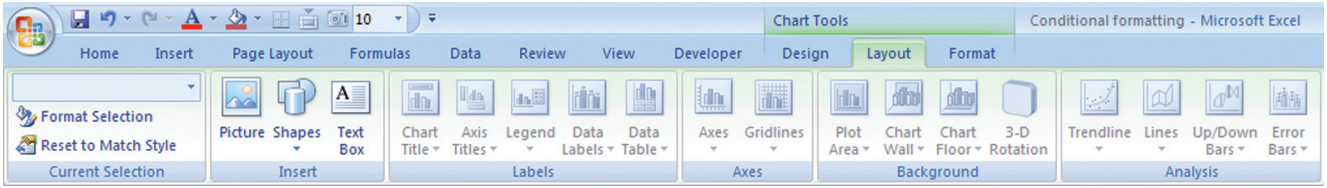
The **Chart tool** menus can then be used to format the charts to the required presentation quality.

Design chart tool



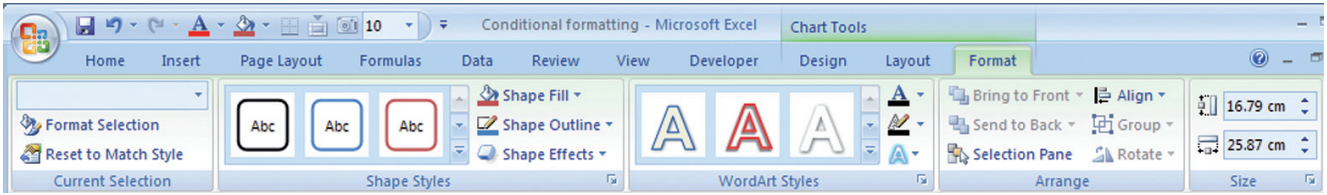
Tool groupings	Function
Chart types	The user can alter the chart type after the initial chart is created. Any chart can then be saved as a repeatable template
Data	Allows the management of chart source data
Chart layout	The user can apply standard chart formats from pre-defined templates. Very quickly allows the introduction of legends, drop lines, gridlines, titles and data labels & tables
Chart styles	The user can pick from a selection of chart formats and styles
Location	Allows the user to move the chart to another sheet

Layout chart tool



Tool groupings	Function
Current selection	Allows the user to choose a part of the chart to format via the drop down box. Once a chart area has been selected, the format selection option allows the user to format that area via a variety of tailored dialogue boxes
Insert	The insert menu allows the user to insert as required pictures, shapes or text boxes
Labels	The user can insert a variety of label choices into the chart
Axes	Axis and gridlines functionality and choice
Background	Background editing functionality
Analysis	The user can add analysis lines to the charts (trend lines, drop lines, movements and error bars etc.)

Format chart tool

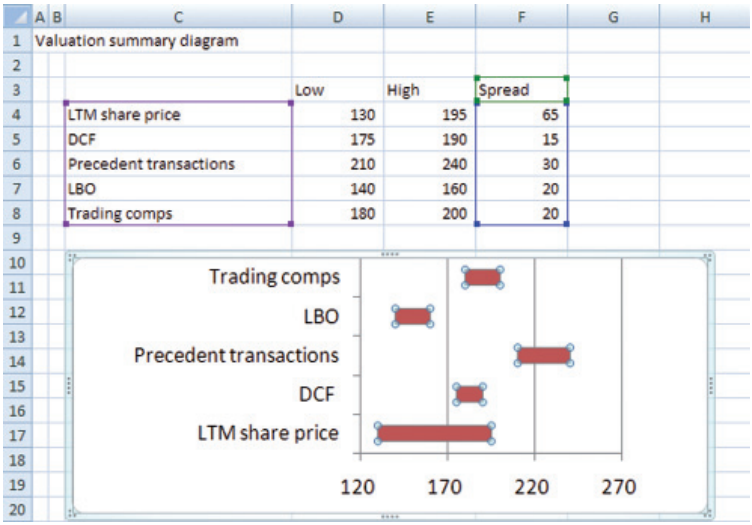


Tool groupings	Function
Current selection	Allows the user to choose a part of the chart to format via the drop down box. Once a chart area has been selected the format selection option allows the user to format that area via a variety of tailored dialogue boxes
Shape styles	Allows the user to format the chart borders
Word art styles	Text formatting functionality within the chart area
Arrange	Allows the user to change the arrangement of the charts
Size	Ability to change the size of the chart

Valuation summary diagrams in 07

The valuation summary diagram below has been set up with the following attributes:

- Stacked bar chart type
- Data series
  - Low (hidden stacked bar with white background format)
  - Spread (visible stacked bar with red background format)
- User defined scales – right click on the X axis – format axis options
- Major gridlines.



Data connections

Run compatibility checker

To ensure that a 07 workbook does not have compatibility issues that cause a significant loss of functionality or a minor loss of fidelity from an earlier version of Excel, you can run the Compatibility Checker.

The Compatibility Checker finds any potential compatibility issues and helps you create a report so that you can resolve them.

1. In 07, open the workbook that requires checking for compatibility
2. Click Microsoft Office Button , click Prepare, and then click Run Compatibility Checker
3. To check the workbook for compatibility every time that you save it, select the Check Compatibility When Saving This Workbook check box
4. To create a report in a separate worksheet of all the issues that are listed in the Summary box, click Copy to New Sheet.

For backward compatibility and collaboration with earlier versions of Microsoft Office Excel, there are two alternative ways to open Microsoft 07 workbooks in an earlier version of Excel. It is possible to use:

- The earlier binary file format (.xls) or
- The new XML-based file format (.xlsx) to exchange workbooks between different versions of Excel.

To ensure that a workbook saved in 07 can be opened in an earlier version of Excel, save a copy that is fully compatible with Excel 97-2003 (.xls) in 07.

It may be easier to download the Microsoft Office Compatibility Pack for 2007 Office Word, Excel and PowerPoint File Formats to install updates and converters for an earlier version of Excel. This allows opening, editing and saving an Excel 2007 workbook in an earlier version of Excel, without having to save it to that version's file format first or without having to upgrade the earlier version of Excel to Excel 2007.

The 2007 Microsoft Office system Compatibility Pack for Excel is available from the Microsoft Office Downloads Web site.

All 07 workbooks that are opened after installing the updates and converters will automatically be converted so that they can be edited and saved without having to upgrade to 07. 07-specific features and formatting may not be displayed in the earlier version of Excel, but they are still available when the workbook is saved and then re-opened in 07.

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